BARGHAUSEN

PRELIMINARY STORMWATER SITE PLAN

Preliminary Plat of Tolt River Terrace

3660 Tolt Avenue
Carnation, WA 98014

City File No. TBD

Prepared for:
MainVue WA, LLC
1110 112th Ave NE, Suite 202
Bellevue, WA 98004

May 23, 2019

Our Job No. 18057

05/23/19

BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH KENT, WA 98032 P) 425-251-6222 F) 425-251-8782
BRANCH OFFICES: TUMWATER, WA KLAMATH FALLS, OR LONG BEACH, CA ROSEVILLE, CA SAN DIEGO, CA
barghausen.com

TABLE OF CONTENTS

Tab 1.0

1.0 PROJECT OVERVIEW

The Plat of Tolt River Terrace project is a proposed residential development consisting of 113 single family homes and 20 townhomes located on a 33.8 acre site. The site contains three existing tax parcels: 212507-9035, 212507-9062, & 212507-9063. The site is located within a portion of the northeast quarter, the northwest quarter, the southeast quarter and the southwest quarter, of the northeast quarter of Section 21, Township 25 North, Range 7 East, Willamette Meridian. Specifically the site is located at 3440 Tolt Avenue in the City of Carnation, Washington. Please reference the Vicinity Map (Figure 1.0.1), located within this section of the report for a visualization of the exact location of the project site.

The site is polygonal in shape and is located to the immediate north of the Tolt River. The western edge of the site is Tolt Avenue, with the Tolt River Trail and Snoqualmie Valley Trail bordering the eastern edge. Immediately north of the site is Tolt Middle School. In the existing condition the sites two western most parcels have been cleared and developed into an industrial storage yard. The eastern most parcel has also been largely cleared and was being used as an industrial maintenance and fabrication yard for concrete structures with two existing gantry cranes and a large warehouse with it's associated out buildings.

Due to a vast majority of the existing site being heavily compacted soils and placed crushed rock two large stormwater detention ponds were created for the purpose of providing water quality treatment and detention for the existing site. The elevations for the site range from 92 to 74. The site slopes in a southwesterly direction following the meandering flow path of the Tolt River.

On-site soils are mapped as mostly Oridia silt loam, with slopes ranging from 0 to 2 percent. Part of the southeastern most portion of the site is mapped as Pilchuck loamy fine sand, with slopes ranging from 0 to 3 percent. For further information please reference the Soil Survey Map (Figure 3.0.1), located in Section 3.0 of this report. For a detailed analysis of the on-site soils please reference the Geotechnical Engineering Report by The Riley Group, Inc. dated August 17, 2016, located in Section 7.0 of this report. All drainage calculations were modeled as till soils.

On-site construction will include roadways with vertical curb and sidewalk, individual lot areas, and open space tracts. The project will also construct two new intersections along Tolt Avenue to provide access to the plat. All on-site roadways to be constructed will be classified as local access roads.

The project will also be constructing multiple onsite stormwater facilities. This includes one large combination detention & water quality pond, one infiltration pond and one separate water quality pond. The large combination detention & water quality pond, and the infiltration pond will provide stormwater flow control and water quality treatment for the site. It should be noted that the soils for the infiltration pond provide the necessary cation exchange rate to fulfill the requirements for water quality treatment. For a detailed analysis of the infiltrative soils and the cation exchange rate please reference the Stormwater Infiltration Evaluation by The Riley Group, Inc. dated January 23, 2017, located in Section 7.0 of this report. The separate water quality pond will provide treatment for the bypass areas that could not be routed to either of the detention ponds.

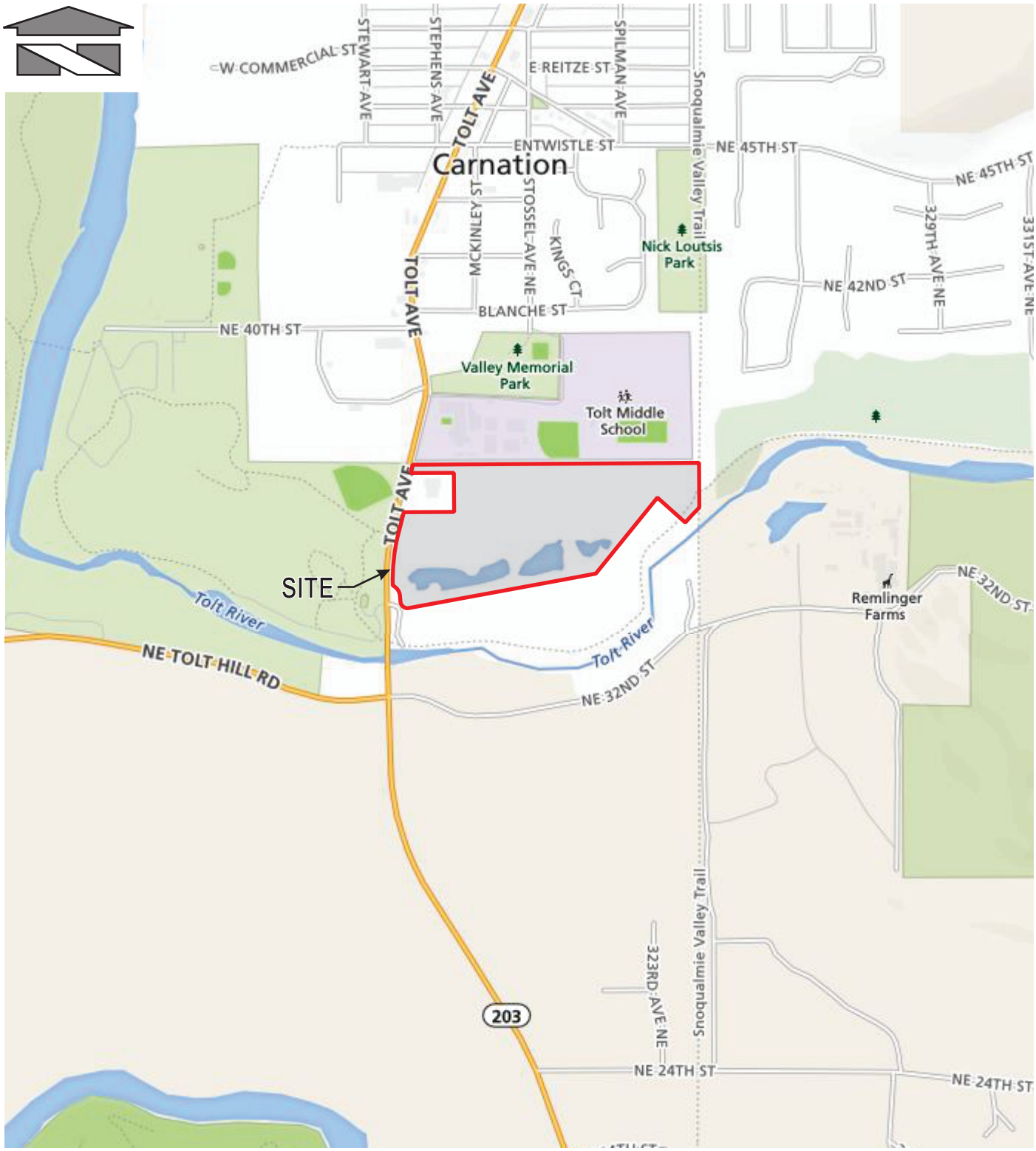
Stormwater runoff from the new on-site pollution-generating impervious surfaces, including the new roadways and driveways, will be collected and piped one of the two onsite detention ponds. The West Detention Pond, located in Tract C near the southwest corner of the site, serves a large portion of the project and is a combination detention & water quality pond. It has been sized to include detention for the bypass areas along the western edge of the site near Tolt Avenue that could not be routed to either of the two ponds. Water quality treatment for the bypass areas will be provided by the separate water quality pond located to the immediate west of the West Detention Pond located within Tract C. Both the West Detention Pond and separate water quality pond discharge to the same downstream system.

The East Infiltration Pond, located in Tract E near the eastern edge of the site, serves the remaining portion of the project. Pretreatment will be provided immediately upstream of the infiltration by a Stormceptor. The East Infiltration Pond was designed to fully infiltrate the 100-year storm event. Water quality is fulfilled by the sufficient cation exchange rate of the on-site soils as previously mentioned.

Site drainage designs are based on the 2012 Stormwater Management Manual for Western Washington (SWMMWW), as Amended in December 2014. Please refer to Section 5.5 of this Stormwater Site Plan, for further details regarding the drainage facility design.

Figure 1.0.1

Vicinity Map



REFERENCE: Rand McNally (2017)

Scale:
Horizontal: **N.T.S.** Vertical: **N/A**

BARGHAUSEN CONSULTING ENGINEERS, INC.

18215 72ND AVENUE SOUTH
KENT, WA 98032
(425) 251-6222
(425) 251-8782

CIVIL ENGINEERING, LAND PLANNING,
SURVEYING, ENVIRONMENTAL SERVICES

For:
Yarington
Carnation, Washington

Title:
VICINITY MAP

Job Number
18057

DATE: 01/23/17

P:\18000s\18057\exhibit\graphics\18057 vmap.cdr

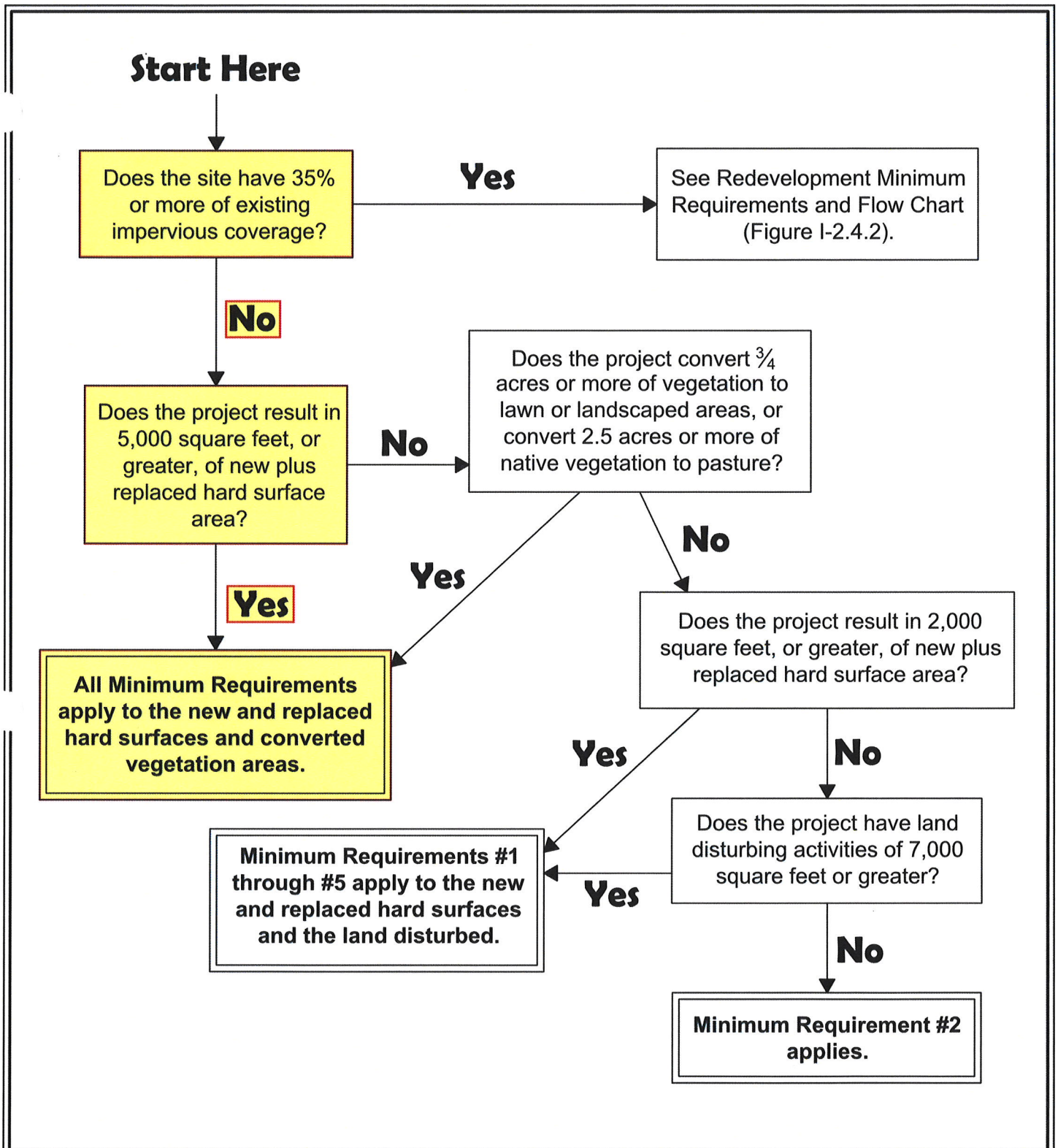
Tab 2.0

2.0 CONDITIONS AND REQUIREMENTS SUMMARY

This section contains the following information:

2.1 Analysis of the Minimum Requirements

2.1 Analysis of the Minimum Requirements



DEPARTMENT OF ECOLOGY
State of Washington

Figure I-2.4.1
Flow Chart for Determining Requirements for New Development

Revised June 2015

2.1 Analysis of the Minimum Requirements

MINIMUM REQUIREMENTS	HOW PROJECT HAS ADDRESSED REQUIREMENT
No. 1: Preparation of Stormwater Site Plans	This Minimum Requirement has been fulfilled by the preparation and completion of this Stormwater Site Plan.
No. 2: Construction Stormwater Pollution Prevention (SWPP)	A completed Construction Stormwater Pollution Prevention Plan (SWPPP) will be submitted separately from, or together with, this report during Final Engineering Review.
No. 3: Source Control of Pollution	Source Controls, such as covered dumpsters, will be applied to the project as applicable.
No. 4: Preservation of Natural Drainage Systems and Outfalls	In the existing condition on-site stormwater runoff is collected by two stormwater ponds. Runoff that is not infiltrated on-site is discharge near the southwest corner of the site and crosses under SR 203, and enters a wetland system to the west. This wetland system meanders westward eventually entering the Snoqualmie River. In the proposed condition the East Infiltration Pond will fully infiltrate the 100-year peak developed storm event for its tributary basin. The West Detention Pond will discharge to the existing discharge location for the two existing ponds, preserving the natural drainage system.
No. 5: On-site Stormwater Management	Due feasibility issues the developer has opted to not meet the LID Performance Standard for Flow Control. As a result, this project will be providing the individual lot BMPs. All soil in the lawn and landscaped areas for the site will be amended to meet the post-Construction Soil Quality and Depth requirement. Each individual lot will have a perforated stub-out connection for rooftops and have permeable pavement driveways.
No. 6: Runoff Treatment	This project proposes the use of a combination detention & water quality pond to treat the areas tributary to the West Detention Pond. The East Infiltration Pond will provide water quality for its tributary area through the cation exchange rate in the soils. All remaining Bypass areas near the western edge of the site along Tolt Avenue will be treated by a separate water quality pond located to the immediate west of the West Detention Pond.
No. 7: Flow Control	Flow Control for the West Detention Pond is provided by matching developed discharge durations to forested durations for the range of pre-developed discharge rates from 50 percent of the two-year peak flow up to the full 50-year peak flow. As required by the 2012 SWMMWW. For the East Infiltration Pond flow control is met by proposing full infiltration of the 100-year post developed storm event for the areas tributary to the pond on-site.
No. 8: Wetlands Protection	There are no documented wetlands recorded on-site.
No. 9: Operation and Maintenance	The drainage facility for this project will be a public facility, owned and maintained by the City. An Operation and Maintenance Manual will be provided in Section 9.0 of this Stormwater Site Plan during Final Engineering Review.

Tab 3.0

3.0 EXISTING CONDITIONS SUMMARY

The Plat of Tolt River Terrace project is a proposed single family residential development consisting of 133 lots located on a 33.8 acre site. In the existing condition the site contains three tax parcels: 212507-9035, 212507-9062, & 212507-9063. An Assessors Map (Figure 3.0.1) has been included within this section of the report for visual reference of the existing on-site parcels. The site is located within a portion of the northeast quarter, the northwest quarter, the southeast quarter and the southwest quarter, of the northeast quarter of Section 21, Township 25 North, Range 7 East, Willamette Meridian. Specifically the site is located at 3440 Tolt Avenue in the City of Carnation, Washington. Please reference the Vicinity Map (Figure 1.0.1), located in Section 1.0 of this report for a visualization of the exact location of the project site.

The site is polygonal in shape and is located to the immediate north of the Tolt River. The western edge of the site is bordered by Tolt Avenue, with the Tolt River Trail and Snoqualmie Valley Trail bordering the eastern edge. Immediately north of the site is Tolt Middle School. In the existing condition the sites two western most parcels have been cleared and developed into an industrial storage yard. The eastern most parcel has also been cleared and was previously being used as an industrial maintenance and fabrication yard to produce concrete related products. This parcel also contains two existing gantry cranes and a large warehouse with it's associated out buildings.

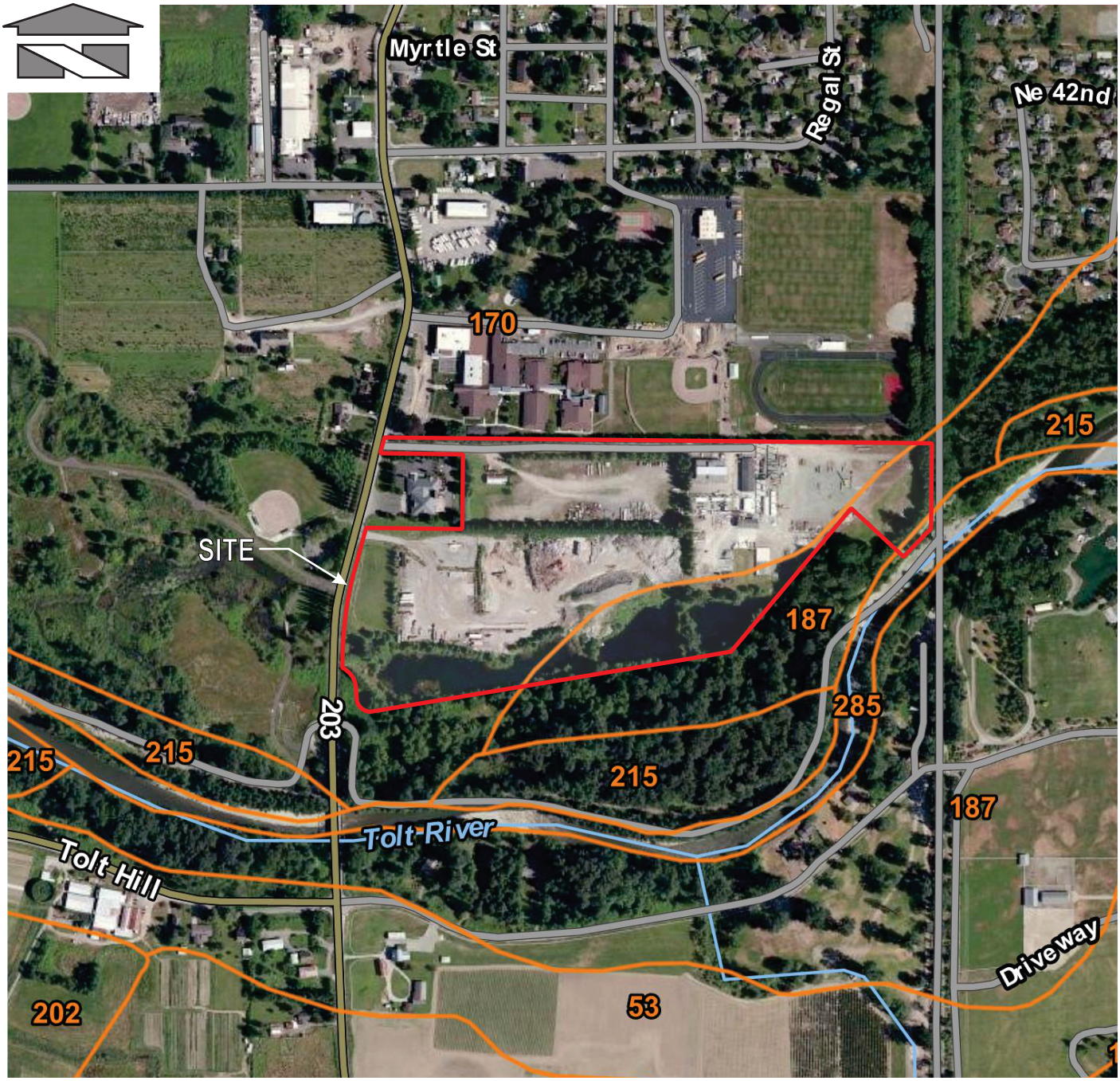
Due to a vast majority of the existing site being heavily compacted soils and placed crushed rock two large stormwater detention ponds were created for the purpose of providing water quality treatment and detention for the existing site. These ponds discharge to a ponded area located near the southwest corner of the site. From here runoff crosses underneath SR 203 and enters a wetland system located to the west of the site, please reference the Sensitive Areas Map (Figure 3.0.2) located within this section of the report. The wetland system continues to meander westward eventually entering the Snoqualmie River.

The elevations for the site range from 92 to 74. The site slopes in a southwesterly direction following the meandering flow path of the Tolt River. On-site soils are mapped as mostly Oridia silt loam, with slopes ranging from 0 to 2 percent. Part of the southeastern most portion of the site is mapped as Pilchuck loamy fine sand, with slopes ranging from 0 to 3 percent. For further information please reference the Soil Survey Map (Figure 3.0.1), located in this section of the report. For a detailed analysis of the on-site soils please reference the Geotechnical Engineering Report by The Riley Group, Inc. dated August 17, 2016, located in Section 7.0 of this report.

It is important to note that portions of the site are within the mapped 100-year floodplain and floodway of the Tolt River, located to the south of the site. Please reference the FEMA Map (Figure 3.0.4) located within this section of the report. However, the developed portion of the site has been removed from the Special Flood Hazard Area (SFHA) through FEMA's LOMAR process. Copies of the LOMARs have been included in Section 3.1 of this report.

Figure 3.0.1

Soil Survey Map



REFERENCE: USDA, Natural Resources Conservation Service

LEGEND:

170 = Oridia silt loam, 0-2% slopes
187 = Pilchuck loamy fine sand, 0-3% slopes
285 = Water

Scale:
Horizontal: **N.T.S.** Vertical: **N/A**

BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH
KENT, WA 98032
(425) 251-6222
(425) 251-8782
CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES

For:
Yarington
Carnation, Washington

Title:
SOIL SURVEY MAP

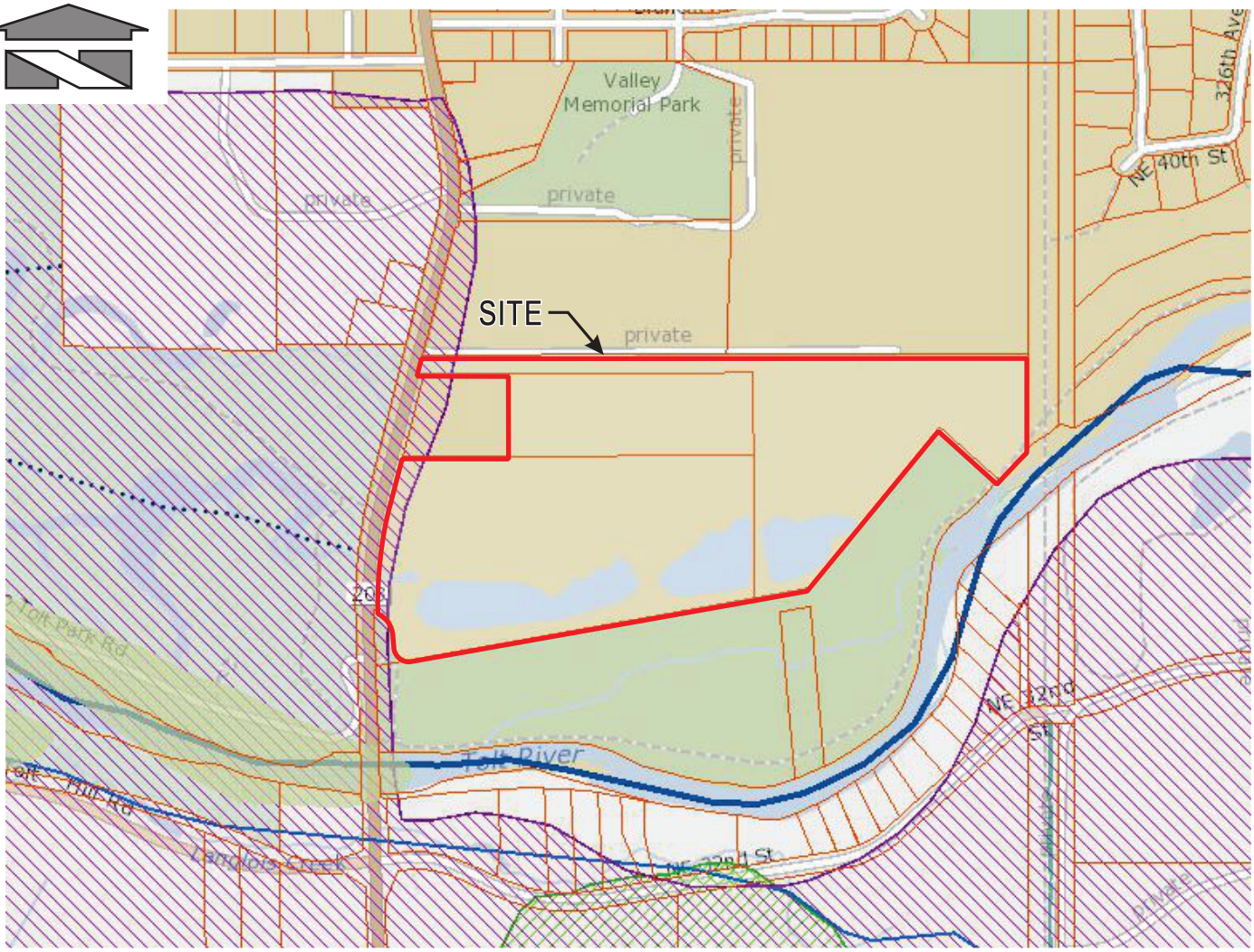
Job Number
18057

DATE: 01/23/17

P:\18000s\18057\exhibit\graphics\18057 soil.cdr

Figure 3.0.2

Sensitive Areas Map



Property Layers

Parcels

Environmentally Sensitive Areas

Erosion hazard (1990 SAO)

Seismic hazard (1990 SAO)

Landslide hazard (1990 SAO)

Coal mine hazard (1990 SAO)

Stream (1990 SAO)

- class 1
- class 2 perennial
- class 2 salmonid
- class 3
- unclassified

Wetland (1990 SAO)

REFERENCE: King County iMAP (2016)

Scale:
Horizontal: **N.T.S.** Vertical: **N/A**

BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH
KENT, WA 98032
(425) 251-6222
(425) 251-8782
CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES

For:
Yarington
Carnation, Washington

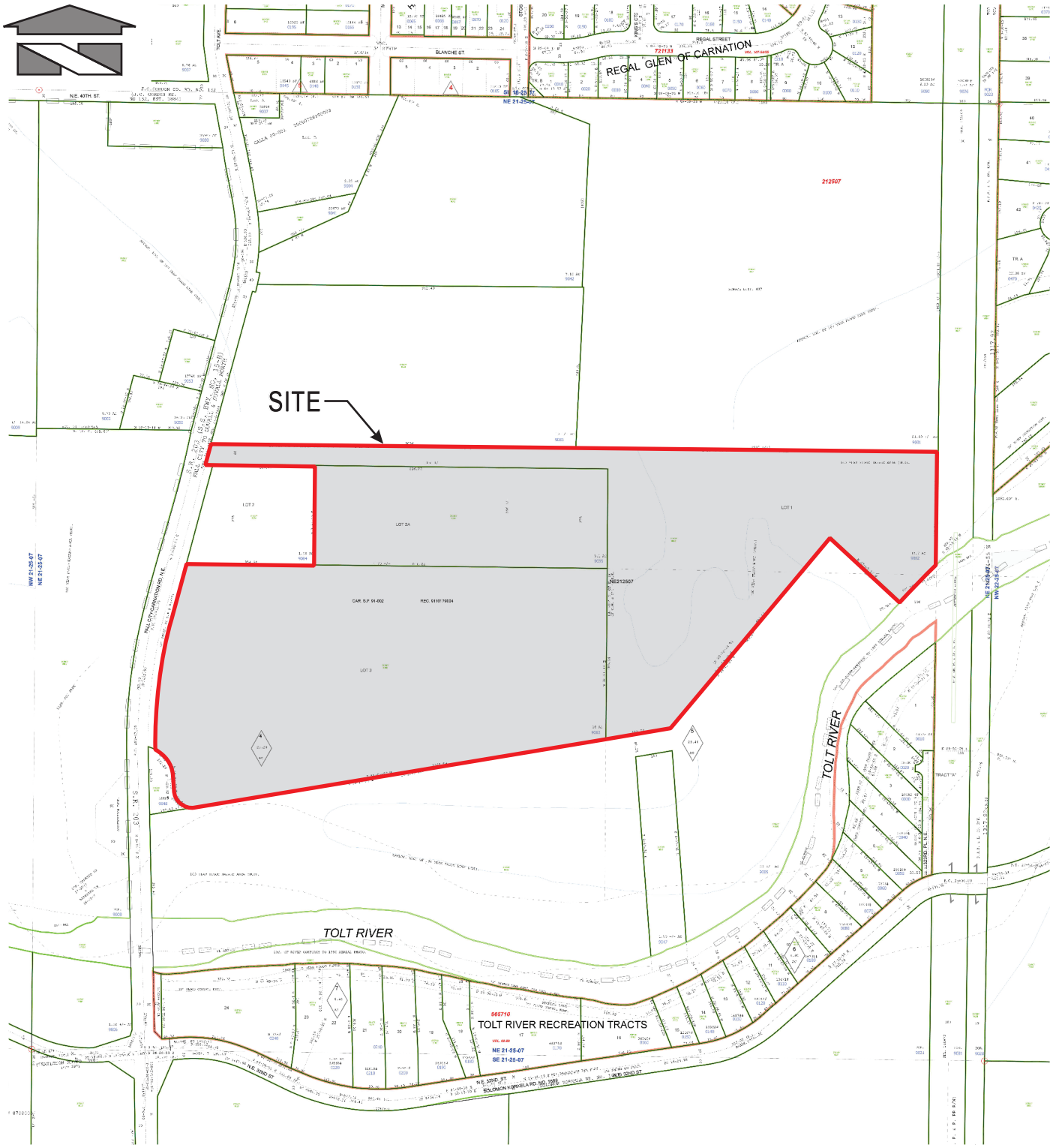
Title:
SENSITIVE AREAS MAP

Job Number
18057

DATE: 01/23/17

P:\18000s\18057\exhibit\graphics\18057 sens.cdr

Figure 3.0.3
Assessor's Map



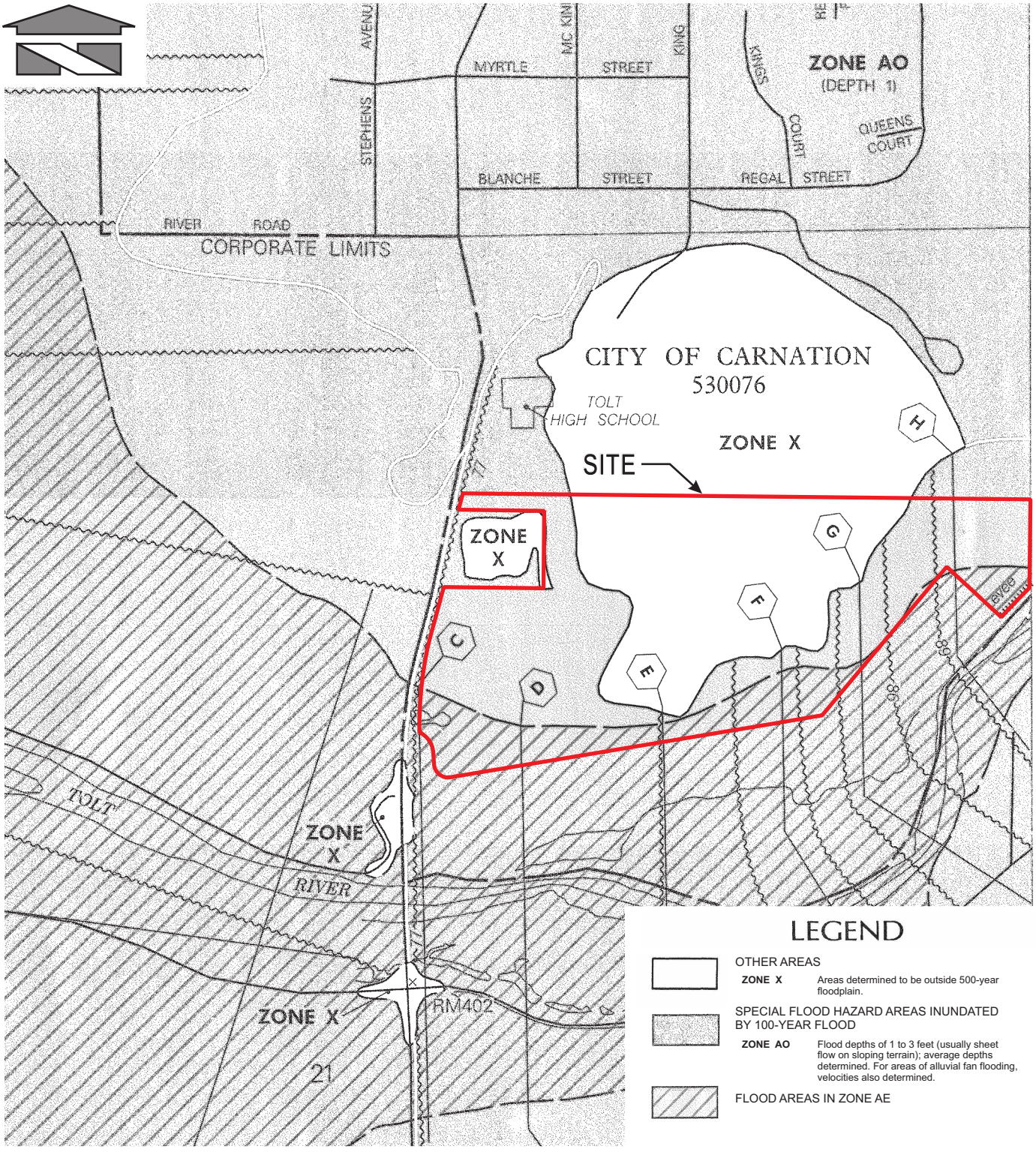
REFERENCE: King County Department of Assessments (Dec. 2015)

Scale: Horizontal: **N.T.S.** Vertical: **N/A**	*For:* Yarington Carnation, Washington	Job Number 18057
BARGHAUSEN CONSULTING ENGINEERS, INC. 18215 72ND AVENUE SOUTH KENT, WA 98032 (425) 251-6222 (425) 251-8782 CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES	*Title:* ASSESSOR MAP	DATE: 01/23/17

P:\18000s\18057\exhibit\graphics\18057 amap.cdr

Figure 3.0.4

FEMA Map



LEGEND

OTHER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

FLOOD AREAS IN ZONE AE

REFERENCE: Federal Emergency Management Agency (Portion of Map 53033C1250 F, May 1995)

Scale:

Horizontal: ***N.T.S.*** *Vertical:* ***N/A***

BARGHAUSEN CONSULTING ENGINEERS, INC.

18215 72ND AVENUE SOUTH
KENT, WA 98032
(425) 251-6222
(425) 251-8782

CIVIL ENGINEERING, LAND PLANNING,
SURVEYING, ENVIRONMENTAL SERVICES

For:

Yarington
Carnation, Washington

Title:

FEMA MAP

Job Number

18057

DATE: 01/23/17

P:\18000s\18057\exhibit\graphics\18057 fema.cdr

3.1 Letters of Map Revision (LOMR) Based on Fill Determination Document (Removal)

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION BASED ON FILL DETERMINATION DOCUMENT (REMOVAL)

COMMUNITY AND MAP PANEL INFORMATION		LEGAL PROPERTY DESCRIPTION
COMMUNITY	CITY OF CARNATION, KING COUNTY, WASHINGTON	Lot 3, as shown on Short Plat No. 91002, recorded as Document No. 9110179004, in Book 83, Page 96, in the Office of the Auditor, King County, Washington The portion of property is more particularly described by the following metes and bounds:
	COMMUNITY NO.: 530076	
AFFECTED MAP PANEL	NUMBER: 53033C0418G	
	DATE: 12/6/2001	
FLOODING SOURCE: SNOQUALMIE RIVER; TOLT RIVER		APPROXIMATE LATITUDE & LONGITUDE OF PROPERTY: 47.641, -121.911 SOURCE OF LAT & LONG: STREETS & TRIPS 2009 DATUM: WGS 84

DETERMINATION

LOT	BLOCK/ SECTION	SUBDIVISION	STREET	OUTCOME WHAT IS REMOVED FROM THE SFHA	FLOOD ZONE	1% ANNUAL CHANCE FLOOD ELEVATION (NGVD 29)	LOWEST ADJACENT GRADE ELEVATION (NGVD 29)	LOWEST LOT ELEVATION (NGVD 29)
	--	--	3440 Tolt Avenue	Portion of Property	X (unshaded)	76.6 to 81.2 feet	--	77.7 to 81.5 feet

Special Flood Hazard Area (SFHA) - The SFHA is an area that would be inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood).

ADDITIONAL CONSIDERATIONS (Please refer to the appropriate section on Attachment 1 for the additional considerations listed below.)

LEGAL PROPERTY DESCRIPTION
PORTIONS REMAIN IN THE FLOODWAY
STUDY UNDERWAY

This document provides the Federal Emergency Management Agency's determination regarding a request for a Letter of Map Revision based on Fill for the property described above. Using the information submitted and the effective National Flood Insurance Program (NFIP) map, we have determined that the described portion(s) of the property(ies) is/are not located in the SFHA, an area inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood). This document revises the effective NFIP map to remove the subject property from the SFHA located on the effective NFIP map; therefore, the Federal mandatory flood insurance requirement does not apply. However, the lender has the option to continue the flood insurance requirement to protect its financial risk on the loan. A Preferred Risk Policy (PRP) is available for buildings located outside the SFHA. Information about the PRP and how one can apply is enclosed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at (877) 336-2627 (877-FEMA MAP) or by letter addressed to the Federal Emergency Management Agency, LOMC Clearinghouse, 6730 Santa Barbara Court, Elkridge, MD 21075.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION BASED ON FILL DETERMINATION DOCUMENT (REMOVAL)

ATTACHMENT 1 (ADDITIONAL CONSIDERATIONS)

LEGAL PROPERTY DESCRIPTION (CONTINUED)

COMMENCING at the Northeast corner of said Lot 3; thence S00°50'59"W, a distance of 25.00 feet to the POINT OF BEGINNING; thence N89°12'58"W, a distance of 70.16 feet; thence N89°09'13"W, a distance of 999.84 feet; thence S01°30'00"W, a distance of 330.00 feet; thence S74°10'00"E, a distance of 385.00 feet; thence S59°45'00"E, a distance of 40.00 feet; thence N29°10'00"E, a distance of 52.00 feet; thence N72°10'00"E, a distance of 215.00 feet; thence S35°00'00"E, a distance of 90.00 feet; thence N56°55'00"E, a distance of 315.00 feet; thence N68°10'00"E, a distance of 135.03 feet; thence N00°50'59"E, a distance of 179.68 feet to the POINT OF BEGINNING.

PORTIONS OF THE PROPERTY REMAIN IN THE FLOODWAY (This Additional Consideration applies to the preceding 1 Property.)

A portion of this property is located within the Special Flood Hazard Area and the National Flood Insurance Program (NFIP) regulatory floodway for the flooding source indicated on the Determination/Comment Document while the subject of this determination is not. The NFIP regulatory floodway is the area that must remain unobstructed in order to prevent unacceptable increases in base flood elevations. Therefore, no construction may take place in an NFIP regulatory floodway that may cause an increase in the base flood elevation, and any future construction or substantial improvement on the property remains subject to Federal, State/Commonwealth, and local regulations for floodplain management. The NFIP regulatory floodway is provided to the community as a tool to regulate floodplain development. Modifications to the NFIP regulatory floodway must be accepted by both the Federal Emergency Management Agency (FEMA) and the community involved. Appropriate community actions are defined in Paragraph 60.3(d) of the NFIP regulations. Any proposed revision to the NFIP regulatory floodway must be submitted to FEMA by community officials. The community should contact either the Regional Director (for those communities in Regions I-IV, and VI-X), or the Regional Engineer (for those communities in Region V) for guidance on the data which must be submitted for a revision to the NFIP regulatory floodway. Contact information for each regional office can be obtained by calling the FEMA Map Assistance Center toll free at (877) 336-2627 (877-FEMA MAP) or from our web site at http://www.fema.gov/about/regoff.htm.

STUDY UNDERWAY (This Additional Consideration applies to all properties in the LOMR-F DETERMINATION DOCUMENT (REMOVAL))

This determination is based on the flood data presently available. However, the Federal Emergency Management Agency is currently revising the National Flood Insurance Program (NFIP) map for the community. New flood data could be generated that may affect this property. When the new NFIP map is issued it will supersede this determination. The Federal requirement for the purchase of flood insurance will then be based on the newly revised NFIP map.

This attachment provides additional information regarding this request. If you have any questions about this attachment, please contact the FEMA Map Assistance Center toll free at (877) 336-2627 (877-FEMA MAP) or by letter addressed to the Federal Emergency Management Agency, LOMC Clearinghouse, 6730 Santa Barbara Court, Elkridge, MD 21075.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION BASED ON FILL DETERMINATION DOCUMENT (REMOVAL)

COMMUNITY AND MAP PANEL INFORMATION		LEGAL PROPERTY DESCRIPTION
COMMUNITY	CITY OF CARNATION, KING COUNTY, WASHINGTON	A portion of Lots 1, 2A, and 3, as shown on the Short Plat No. 91002 recorded as Document No. 9110179004, in Book 83, Page 96, in the Office of the Auditor, King County, Washington The portion of property is more particularly described by the following metes and bounds:
	COMMUNITY NO.: 530076	
AFFECTED MAP PANEL	NUMBER: 53033C0418G	
	DATE: 12/6/2001	
FLOODING SOURCE: TOLT RIVER		APPROXIMATE LATITUDE & LONGITUDE OF PROPERTY: 47.640, -121.913 SOURCE OF LAT & LONG: GOOGLE EARTH PRO DATUM: NAD 83

DETERMINATION

LOT	BLOCK/ SECTION	SUBDIVISION	STREET	OUTCOME WHAT IS REMOVED FROM THE SFHA	FLOOD ZONE	1% ANNUAL CHANCE FLOOD ELEVATION (NGVD 29)	LOWEST ADJACENT GRADE ELEVATION (NGVD 29)	LOWEST LOT ELEVATION (NGVD 29)
	--	Short Plat No. 91002	3660 Tolt Avenue	Portion of Property	X (shaded)	--	--	76.9 feet

Special Flood Hazard Area (SFHA) - The SFHA is an area that would be inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood).

ADDITIONAL CONSIDERATIONS (Please refer to the appropriate section on Attachment 1 for the additional considerations listed below.)

LEGAL PROPERTY DESCRIPTION
DETERMINATION TABLE (CONTINUED)
PORTIONS REMAIN IN THE FLOODWAY
FILL RECOMMENDATION
STUDY UNDERWAY

This document provides the Federal Emergency Management Agency's determination regarding a request for a Letter of Map Revision based on Fill for the property described above. Using the information submitted and the effective National Flood Insurance Program (NFIP) map, we have determined that the described portion(s) of the property(ies) is/are not located in the SFHA, an area inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood). This document revises the effective NFIP map to remove the subject property from the SFHA located on the effective NFIP map; therefore, the Federal mandatory flood insurance requirement does not apply. However, the lender has the option to continue the flood insurance requirement to protect its financial risk on the loan. A Preferred Risk Policy (PRP) is available for buildings located outside the SFHA. Information about the PRP and how one can apply is enclosed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at (877) 336-2627 (877-FEMA MAP) or by letter addressed to the Federal Emergency Management Agency, LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION BASED ON FILL DETERMINATION DOCUMENT (REMOVAL)

ATTACHMENT 1 (ADDITIONAL CONSIDERATIONS)

LEGAL PROPERTY DESCRIPTION (CONTINUED)

A portion of Lot 1:
Beginning at the Northeast corner of said Lot 1; thence N89°12'58"W along the North line of said Lot 1 for a distance of 970.38 feet to an angle point; thence N89°09'13"W, continuing along said North line for a distance of 400.00 feet; thence S00°50'47"W, leaving said North line, for a distance of 11.00 feet; thence N89°09'13"W, along a line parallel with and 11.00 feet South of, as measured perpendicular to, said North line for a distance of 265.00 feet; thence S70°00'00"W, leaving said parallel line, for a distance of 80.00 feet; thence S08°15'00"E for a distance of 20.79 feet to a point on the North line of Lot 2A of said Short Plat, said point being S89°09'15"E a distance of 9.37 feet from the Northwest corner thereof; thence S89°09'13"E along said North line of Lot 2A for a distance of 736.51 feet to an angle point; thence S89°12'58"E, continuing along said north line for a distance of 70.34 feet to the northeast corner of said Lot 2A; thence S00°50'59"W along the east line of Lot 2A and Lot 3 of said Short Plat for a distance of 479.68 feet; thence N84°29'20"E, leaving said East line for a distance of 164.46 feet; thence N68°30'00"E for a distance of 75.00 feet; thence N90°00'00"E for a distance of 142.00 feet; thence N39°00'00"E for a distance of 105.00 feet; thence N53°00'00"E for a distance of 85.00 feet to a point on the South line of said Lot 1; thence N40°03'23"E along said South line for a distance of 160.00 feet to an angle point; thence S46°14'53"E, continuing along said South line for a distance of 53.00 feet; thence N45°00'00"E, leaving said South line, for a distance of 162.00 feet; thence N47°00'00"E for a distance of 194.06 feet to a point on the East line of said Lot 1; thence N00°50'59"E along said East line for a distance of 50.15 feet to the Northeast comer of said Lot 1, the POINT OF BEGINNING

A portion of Lot 2A:
Commencing at the Northwest comer of said Lot 2A; thence S89°09'15"E along the North line of said Lot 2A for a distance of 9.37 feet to the TRUE POINT OF BEGINNING; thence S08°15'00"E, leaving said North line for a distance of 199.21 feet; thence S28°24'52"W for a distance of 88.33 feet to the Southwest comer of said Lot 2A; thence S89°09'13"E along the South line of said Lot 2A for a distance of 746.04 feet to an angle point; thence S89°12'58"E, continuing along said South line, for a distance of 70.18 feet to the Southeast comer of said Lot 2A; thence N00°50'59"E along the East line of said Lot 2A for a distance of 275.00 feet to the Northeast comer of said Lot 2A; thence N89°12'58"W along the North line of said Lot 2A for a distance of 70.34 feet to an angle point; thence N89°09'13"W, continuing along said north line for a distance of 736.51 feet to the POINT OF BEGINNING

A portion of Lot 3:
Beginning at the Northeast corner of said Lot 3; thence S89°12'58"W along the North line of said Lot 3 for a distance of 70.18 feet to an angle point; thence S89°09'13"W, continuing along said North line for a distance of 746.04 feet to the Southwest corner of Lot 2A of said Short Plat; thence S00°51'00"W, leaving said North line for a distance of 25.00 feet; thence S89°09'13"E along a line parallel with and 25.00 feet South of as measured perpendicular to said North line for a distance of 746.06 feet to an angle point; thence S89°12'58"E, continuing

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION BASED ON FILL DETERMINATION DOCUMENT (REMOVAL)

ATTACHMENT 1 (ADDITIONAL CONSIDERATIONS)

along said parallel line, for a distance of 70.16 feet to the East line of said Lot 3; thence N00°50'59"E along said East line for a distance of 25.00 feet to the Northeast corner of said Lot 3, the POINT OF BEGINNING

DETERMINATION TABLE (CONTINUED)

LOT	BLOCK/ SECTION	SUBDIVISION	STREET	**OUTCOME** WHAT IS REMOVED FROM THE SFHA	FLOOD ZONE	1% ANNUAL CHANCE FLOOD ELEVATION (NGVD 29)	LOWEST ADJACENT GRADE ELEVATION (NGVD 29)	LOWEST LOT ELEVATION (NGVD 29)
2A	--	Short Plat No. 91002	3700 Tolt Avenue	Portion of Property	X (shaded)	--	--	78.0 feet
3	--	Short Plat No. 91002	3440 Tolt Avenue	Portion of Property	X (shaded)	--	--	79.6 feet

PORTIONS OF THE PROPERTY REMAIN IN THE FLOODWAY (This Additional Consideration applies to the preceding 3 Properties.)

A portion of this property is located within the Special Flood Hazard Area and the National Flood Insurance Program (NFIP) regulatory floodway for the flooding source indicated on the Determination/Comment Document ... e the subject of this determination is not. The NFIP regulatory floodway is the area that must remain unobstructed in order to prevent unacceptable increases in base flood elevations. Therefore, no construction may take place in an NFIP regulatory floodway that may cause an increase in the base flood elevation, and any future construction or substantial improvement on the property remains subject to Federal, State/Commonwealth, and local regulations for floodplain management. The NFIP regulatory floodway is provided to the community as a tool to regulate floodplain development. Modifications to the NFIP regulatory floodway must be accepted by both the Federal Emergency Management Agency (FEMA) and the community involved. Appropriate community actions are defined in Paragraph 60.3(d) of the NFIP regulations. Any proposed revision to the NFIP regulatory floodway must be submitted to FEMA by community officials. The community should contact either the Regional Director (for those communities in Regions I-IV, and VI-X), or the Regional Engineer (for those communities in Region V) for guidance on the data which must be submitted for a revision to the NFIP regulatory floodway. Contact information for each regional office can be obtained by calling the FEMA Map Assistance Center toll free at (877) 336-2627 (877-FEMA MAP) or from our web site at http://www.fema.gov/about/regoff.htm.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION BASED ON FILL DETERMINATION DOCUMENT (REMOVAL)

ATTACHMENT 1 (ADDITIONAL CONSIDERATIONS)

FILL RECOMMENDATION (This Additional Consideration applies to the preceding 3 Properties.)

The minimum NFIP criteria for removal of the subject area based on fill have been met for this request and the community in which the property is located has certified that the area and any subsequent structure(s) built on the filled area are reasonably safe from flooding. FEMA's Technical Bulletin 10-01 provides guidance for the construction of buildings on land elevated above the base flood elevation through the placement of fill. A copy of Technical Bulletin 10-01 can be obtained by calling the FEMA Map Assistance Center toll free at (877) 336-2627 (877-FEMA MAP) or from our web site at http://www.fema.gov/mit/tb1001.pdf. Although the minimum NFIP standards no longer apply to this area, some communities may have floodplain management regulations that are more restrictive and may continue to enforce some or all of their requirements in areas outside the Special Flood Hazard Area.

STUDY UNDERWAY (This Additional Consideration applies to all properties in the LOMR-F DETERMINATION DOCUMENT (REMOVAL))

This determination is based on the flood data presently available. However, the Federal Emergency Management Agency is currently revising the National Flood Insurance Program (NFIP) map for the community. New flood data could be generated that may affect this property. When the new NFIP map is issued it will supersede this determination. The Federal requirement for the purchase of flood insurance will then be based on the newly revised NFIP map.

This attachment provides additional information regarding this request. If you have any questions about this attachment, please contact the FEMA Map Assistance Center toll free at (877) 336-2627 (877-FEMA MAP) or by letter addressed to the Federal Emergency Management Agency, LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605.

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

Tab 4.0

4.0 OFF-SITE ANALYSIS REPORT

An Off-Site Analysis Report was prepared by Ed McCarthy P.E., P.S. who has a PhD in Water Resources Engineering and over 25 years of experience consulting within the field of Water Resources Engineering on the effects of residential and commercial development. This report fulfills the requirements for an Off-Site Analysis per the 2012 SWMMWW and can be found within Section 4.1 of this document.

4.1 Yarington Development Level 1 Downstream Drainage Analysis prepared by Ed McCarthy, P.E., P.S., dated February 1, 2017

Yarington Development

LEVEL 1 DOWNSTREAM DRAINAGE ANALYSIS

CITY OF CARNATION FILE NO.

Prepared by:

Ed McCarthy, P.E., P.S.
9957 171st Avenue SE
Renton, WA 98059
Tel. (425) 271-5734
Fax (425) 271-3432

Submitted to:

City of Carnation
450 110th Avenue NE
Bellevue, WA 98009

February 1, 2017

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TASK 1: STUDY AREA DEFINITION AND MAPS

Site Description

The Yarington Development is a proposed 124-lot single-family residential plat on 33.8 acres. The subject property is located at 3440 Tolt Avenue in Carnation, WA (Figure 1). The portion of the site that will be developed is located entirely within Subbasin SQR4 of the Snoqualmie River watershed.

The site is bordered on the north by the Tolt Middle School. A fire station is located adjacent to the northwest corner of the site. A riparian area to the Tolt River is located along the south boundary of the site. The majority of the proposed project area has been cleared and graded. The cleared area of the site is flat with soil stock piles scattered in various locations. Two large ponds are located along the south portion of the site. This pond system discharges to the west.

TASK 2: RESOURCE REVIEW

Based on a review of available resources, including the County's *Sensitive Areas Map Folio* (King County Department of Parks, Planning, and Resources, 1990), the site and downstream system within 1 mile from the site are characterized as follows:

- Critical Drainage Area Map

  Runoff from the site drains to a tributary to the Snoqualmie River. The downstream drainage system is a complex of open water wetlands.

- Floodplain/Floodway (FEMA) Maps

  Portions of the site are within the mapped 100-year floodplain and floodway of the Tolt River. The developed portion of the site has been removed from the Special Flood Hazard Area (SFHA) through FEMA's LOMR process.

- Offsite Analysis Reports

  King County's GIS for the stream networks and wetlands were used in helping to assess the drainage course downstream from the project site.

- Basin Plans

  The site is within the Snoqualmie River watershed. No specific basin plan with established stormwater recommendations has been developed that exceed the required stormwater management requirements.

- Sensitive Area Information

  Based on iMAP from the King County website and the *Sensitive Areas Map Folio*, the potion of the site proposed for development is not located within a coal mine, seismic, landslide, or wetland area. A Channel Migration Zone (CMZ) associated with the Tolt River is located along the south portion of the site. The downstream

drainage course from the site discharges to floodplains and wetlands associated with the Snoqualmie River.

- Drainage Complaints

  Based on King County's database of registered drainage complaints, no relevant complaints within one mile from the site are on record.

- King County Soils Map

  The site is outside the study area of the King County Soil Survey (U.S. Department of Agriculture, 1973).

TASK 3: FIELD INSPECTION

A downstream drainage analysis for the site is presented in this section. The site drains to the west where it discharges to a stream channel/wetland complex that connects to the Snoqualmie River (Figure 2). The proposed developed portion of the site represents a single threshold discharge area. The drainage course from the site was assessed on 1/20/17. The downstream conveyance system is described below and illustrated in Figure 3. Further descriptions of drainage features are summarized in Table 1.

Upstream Drainage

No offsite upgradient tributary areas contribute runoff onto the project site. Drainage from offsite properties to the north is intercepted by an access road along the north property boundary and conveyed to the west (Location 1 in Figure 3 and Table 1). Topography adjacent to the site's east, west and south boundaries slopes away from the subject site. The natural riparian area to the south of the site drains to the Tolt River (Location 2).

Onsite Drainage

The topography of the site is flat and therefore surface water collects in low areas of the site during times of high rainfall (Location 3; Photos 1 and 2 in Appendix A). Runoff from the site generally flows from east to west/southwest. A single catch basin was identified in the south central portion of the site that discharges to one of the onsite ponds to the south. Sheet flow leaving the west property boundary is collected in a roadside ditch (Location 6) along SR 203 and conveyed to the south. Other sheet flow from the site is collected in the two ponds located along the south portion of the site (Location 4; Photo 3). The onsite ponds are affected by high groundwater and flood flows from the Tolt River. Infiltration from the ponds likely occurs when underlying water tables are lower.

Downstream Drainage Course

Runoff collected in the roadside ditch along SR 203 and outflow from the ponds collects in a ponded wetland area (Location 5; Photos 4) before flowing to a 60-inch diameter CMP that crosses under SR 203 (Location 7; Photo 5). On the west side of SR 203, the channel/wetland (Location 8; Photo 6) expands in width and flows under a pedestrian bridge before further widening into a broad open

water wetland (Location 9; Photo 7). From Location 9, the wetland continues in a westerly direction (Location 10; Photo 8). Beyond Location 10, the wetland complex continues to the west, passing through a riparian area that has recently been restored by King County's Right Bank Lower Tolt Restoration project and then merges with the Snoqualmie River (Location 11). The drainage course then follows the Snoqualmie River for a distance beyond 1 mile from the subject site (Location 12).

The wetland system from Locations 8 to 11 is a low gradient system and the hydrology is apparently directly affected by stage in the Snoqualmie River. No signs of erosion were noted along the drainage course.

TASK 4: DRAINAGE SYSTEM DESCRIPTION AND PROBLEM DESCRIPTIONS

Downstream Drainage Complaints

There are no recorded drainage complaints or obvious drainage-related problems in the downstream system.

TASK 5: MITIGATION OF EXISTING OR POTENTIAL PROBLEMS

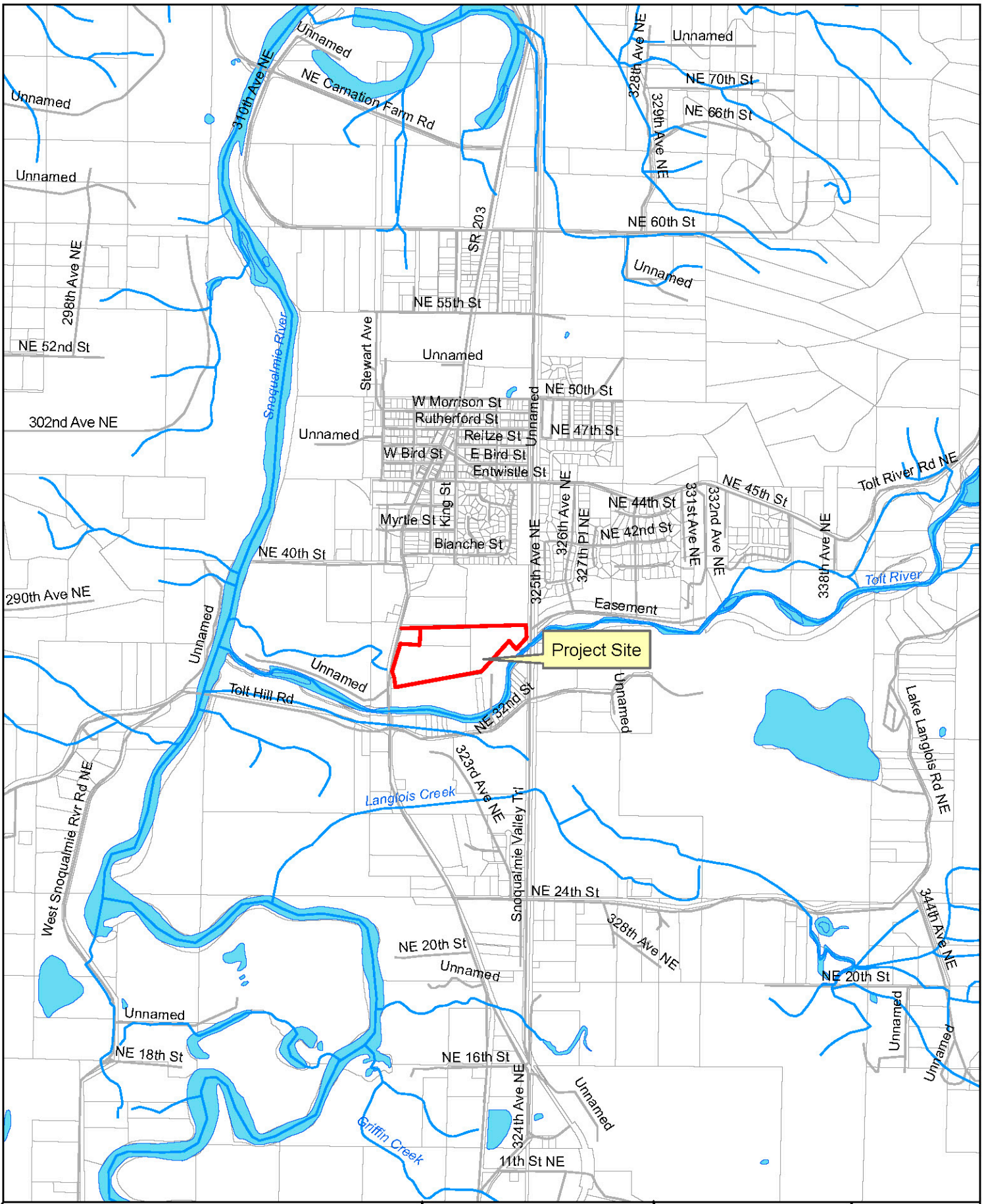
Stormwater Design

Conservation flow control standards are required based on the county's flow control applications map (King County Department of Natural Resources, 2015). Adopting these flow control standards will result in reduced flow rates from the site relative to existing conditions. Adopting conservation flow control standards will ensure that hydrologic conditions downstream from the site would not be degraded.

Under developed conditions, stormwater will be managed in two onsite stormwater facilities. Stormwater from the east portion of the developed site will be collected and infiltrated onsite in a stormwater infiltration pond. Stormwater from the west portion of the developed site will be collected and detained onsite in a detention pond prior to being discharged to the westerly drainage course that flows to a tributary to the Snoqualmie River. Flow control best management practices (BMPs), including infiltration and lot size reduction, will be incorporated into the drainage design to meet requirements for onsite flow control.

Water Quality Treatment

The site is in an area mapped for Basic Water Quality Treatment. A basic wetpond will be used to treat the runoff.



Vicinity Map

Yarington Plat — Level 1 Downstream Drainage Analysis

Carnation, Washington

2,000 Feet

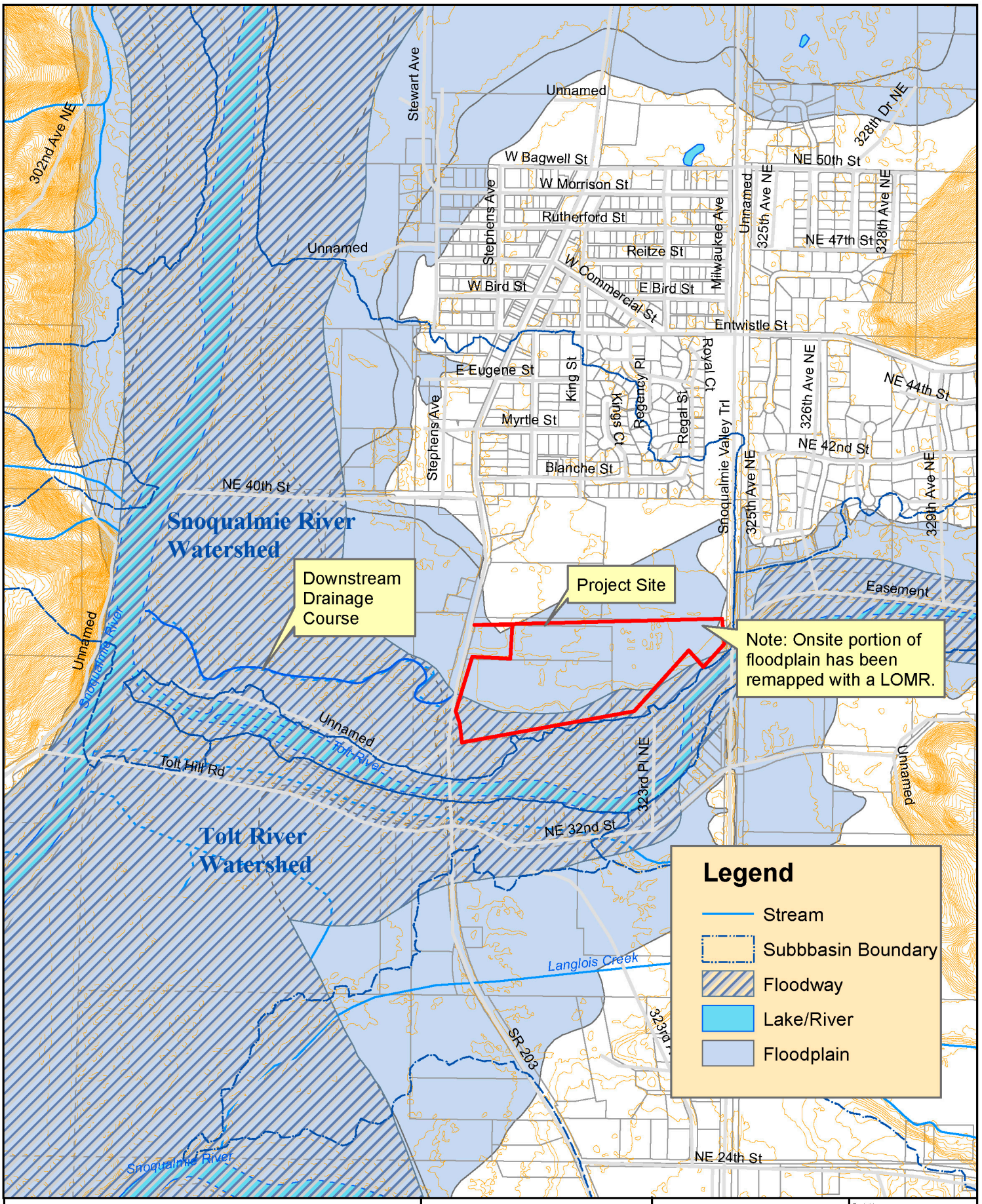
Ed McCarthy, PE, PS
9957 171st Avenue SE
Renton, Washington 98059
Phone: (425) 271-5734

Proj. No.

Date 1/20/17

Figure 1

Slte: Section 21 Range 5E Township 25N



Basin Map

Yarington Plat — Level 1 Downstream Drainage Analysis

Carnation, Washington

1,000 Feet

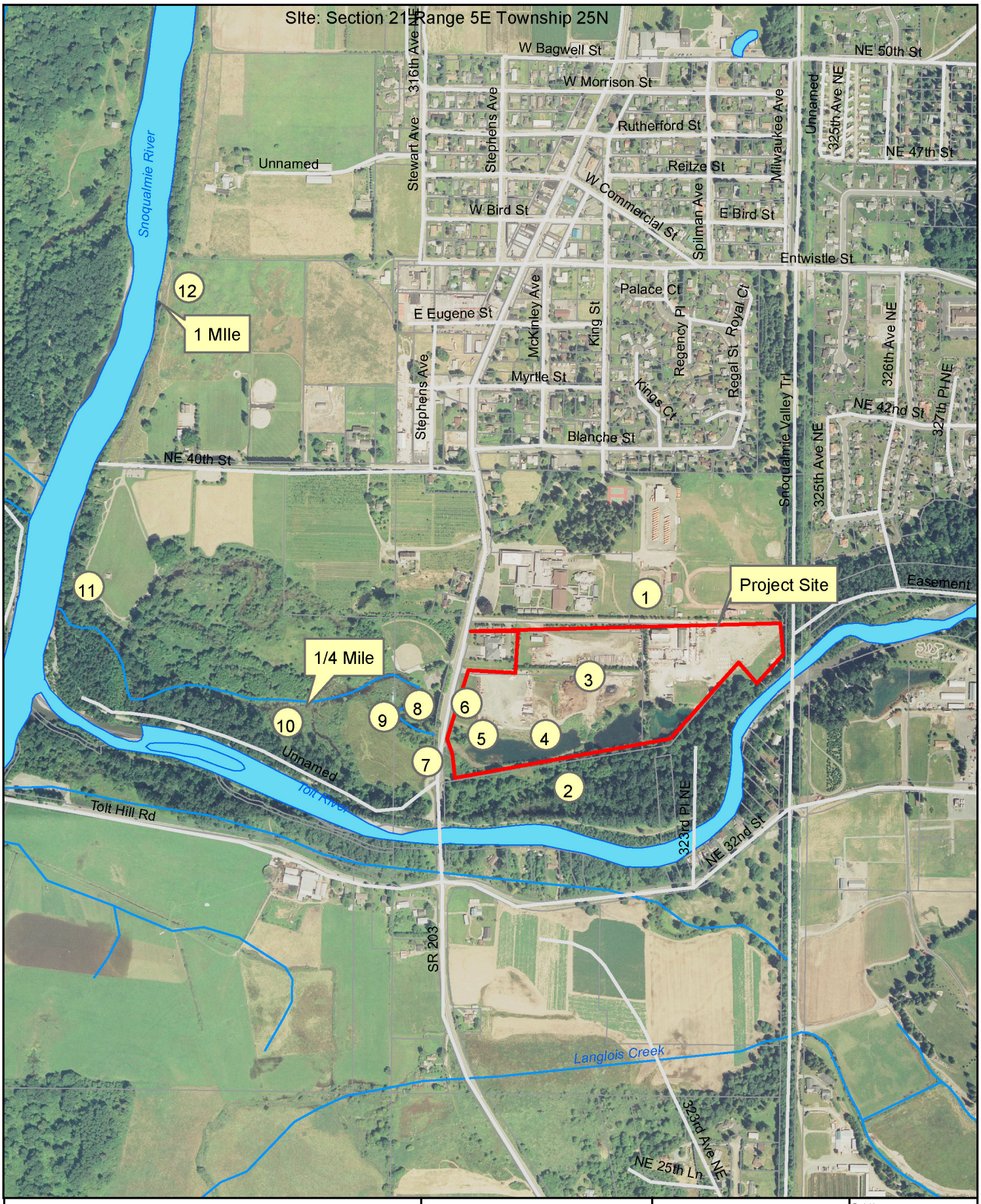
Ed McCarthy, PE, PS

9957 171st Avenue SE
Renton, Washington 98059
Phone: (425) 271-5734

Proj. No.

Date 1/20/17

Figure 2



Downstream Drainage Course

Yarington Plat — Level 1 Downstream Drainage Analysis

Carnation, Washington

800 Feet

Ed McCarthy, PE, PS

9957 171st Avenue SE
Renton, Washington 98059
Phone: (425) 271-5734

Proj. No.

Date 1/20/17

Figure 3

Table 1. Description of Downstream Conveyance System

Site Visit on 1/20/17

Basin: **Tributary to Snoqualmie River** Weather: Clear, 42 °F

Location ID	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from Site Discharge	Existing Problems	Potential Problems	Observations of Field Inspector, Resource Reviewer, or Resident
See Fig. 3	Type: sheet flow, swale, stream, channel, pipe. Size: diameter, width	drainage basin, vegetation, cover, depth, type of sensitive area	(%)	1/4 mile=1,320 ft (FT)	constrictions, under capacity, ponding, overtopping, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
1	Offsite – north – sheet/shallow flow	Tolt River Middle School located to north	0-2	-			Access road along north property boundary intercepts drainage from north and conveys it to the west
2	Offsite – south - sheet flow	River riparian buffer/wetland	0-1	-			Area drains to riparian buffer to Tolt River
3	Onsite - sheet	Cleared and graded area	0-1	-	Surface water accumulation on site after heavy rainfall.		
4	Onsite - ponds	Stormwater ponds	0-1	-	Infiltration capacity likely limited by high groundwater during winter		Pond hydrology affected by floodwater from the Tolt River and groundwater
5	Berm/outlet channel	Channel/wetland	0-1	-			Open water at time of site visit; water collects at this location and then flows to culvert under SR 203
6	Roadside ditch Depth=3.0’ Bot. Width=2.5’ Side Slopes=3:1 Slope=1%	Grass-lined ditch/swale	0-1	-	No signs of capacity problems		Ditch collects runoff from west portion of site
7	SR-203 – Culvert 60-inch diameter CMP HW:D = 1.0	SR 203 crossing	0-1	0-100	No signs of capacity problems		

Table 1 (continued)

Basin: **Tributary to Snoqualmie River**

Location ID	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from Site Discharge	Existing Problems	Potential Problems	Observations of Field Inspector, Resource Reviewer, or Resident
See Fig. 3	Type: sheet flow, swale, stream, channel, pipe. Size: diameter, width	drainage basin, vegetation, cover, depth, type of sensitive area	(%)	1/4 mile=1,320 ft (FT)	constrictions, under capacity, ponding, overtopping, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
8	Channel/Wetland	Open water – channel widens on west side of SR 203	0-1	100-400			
9	Broad stream channel/wetland	Channel becomes wider after crossing under pedestrian bridge	0-1	400-800			Pedestrian bridge crosses channel
10	Broad stream channel/wetland	Open water wetland	0-1	800-1,320			
11	Confluence with Snoqualmie River		0-1	3,200			Riparian area has recently been restored by King County's Right Bank Lower Tolt restoration project
12	Snoqualmie River		0-1	5,280			

REFERENCES

King County Department of Natural Resources, 2009. *King County Surface Water Design Manual*. Seattle.

King County Department of Parks, Planning, and Resources, 1990. *Sensitive Areas Map Folio*. Seattle.

U.S. Department of Agriculture, Soil Conservation Service, 1973. *Soil Survey of King County Area, Washington.* Seattle.

Appendix A. Photos of the Site and Downstream System

Appendix A: Photos of the Downstream System

▼ Photo Number 1	
Date of Photo:	1-20-17
Location:	Western entry to subject site looking east.
Description:	The site has been cleared and graded. The topography is flat with several puddles collecting surface water across the site.

▼ Photo Number 2	
Date of Photo:	1-20-17
Location:	South central portion of subject site looking west.
Description:	The site generally drains from east to southwest, mostly by sheet flow.

Appendix A.2: Photos of the Downstream System

▼ Photo Number 3	
Date of Photo:	1-20-17
Location:	Location 5 in Figure 4 looking east
Description:	Two ponds are located along the southern portion of the site.

▼ Photo Number 4	
Date of Photo:	1-20-17
Location:	Location 5 in Figure 4 looking west.
Description:	A berm separates the site's westerly pond from the site's discharge location that flows to a culvert under SR 203.

Appendix A.2: Photos of the Downstream System

▼ Photo Number 5	
Date of Photo:	1-20-17
Location:	Location 7 in Figure 4 looking downstream.
Description:	A 60-inch diameter culvert conveys flows under SR 203.

▼ Photo Number 6	
Date of Photo:	1-20-17
Location:	Location 8 in Figure 4 looking downstream.
Description:	The channel significantly widens once crossing to the west side of SR-203.

Appendix A.2: Photos of the Downstream System

▼ Photo Number 7	
Date of Photo:	1-20-17
Location:	Location 9 in Figure 4 looking downstream.
Description:	The open water component of the channel/wetland system further widens beyond the pedestrian bridge.

▼ Photo Number 8	
Date of Photo:	1-20-17
Location:	Location 10 in Figure 4 looking south.
Description:	The wetland system hydrology is directly affected by the Snoqualmie River.

Tab 5.0

5.0 PERMANENT STORMWATER CONTROL PLAN

This section contains the following information:

5.1 Existing Site Hydrology

5.2 Developed Site Hydrology

5.3 Performance Standards and Goals

5.4 Low Impact Development Features

5.5 Flow Control System

5.6 Water Quality System

5.7 Conveyance System Analysis and Design

5.1 Existing Site Hydrology

Under the existing conditions the topography of the site is flat and therefore surface water collects in low areas of the site during times of high rainfall. Runoff from the site generally flows from east to west/southwest. A single catch basin was identified in the south central portion of the site that discharges to one of the onsite ponds to the south. Sheet flow leaving the west property boundary is collected in a roadside ditch along SR 203 and conveyed to the south. Other sheet flow from the site is collected in the two ponds located along the south portion of the site. The onsite ponds are affected by high groundwater and flood flows from the Tolt River. Infiltration from the ponds likely occurs when underlying water tables are lower.

On-site soils are mapped as mostly Oridia silt loam, with slopes ranging from 0 to 2 percent. Part of the southeastern most portion of the site is mapped as Pilchuck loamy fine sand, with slopes ranging from 0 to 3 percent. For further information please reference the Soil Survey Map (Figure 3.0.1), located in Section 3.0 of this report.

There are no off-site or upstream tributary areas contributing runoff onto the project site. Drainage from offsite properties to the north is intercepted by an access road along the north property boundary and conveyed west towards SR 203. Topography adjacent to the site's east, west and south boundaries slopes away from the subject site. The natural riparian area to the south of the site drains to the Tolt River.

In the developed condition there will be two separate drainage basins. One draining to the West Detention Pond located in Tract C. The other draining to the East Infiltration Pond located in Tract E. Both basins will be modeled as fully forested in the predeveloped condition. Please refer to the Predeveloped Basin Map (Figure 5.1.1), located within this section for a visualization of the overall basin areas. The total basin areas and surface area coverages for each basin are detailed in the tables below.

Predeveloped Basins

The Predeveloped Basin tributary to the West Detention Pond can be broken down as follows:

Impervious	Pervious	Total Area
0.00 Ac	14.70 Ac(1)	14.70 Ac

Notes:

1. Existing Till Forest

The Predeveloped Basin tributary to the East Infiltration Pond can be broken down as follows:

Impervious	Pervious	Total Area
0.00 Ac	8.04 Ac(1)	8.04 Ac

Notes:

1. Existing Till Forest

For a detailed explanation of the procedures used for the sizing of the proposed detention ponds please reference Section 5.4 of this report.

Figure 5.1.1

Predeveloped Basin Map

PREDEVELOPED BASIN MAP

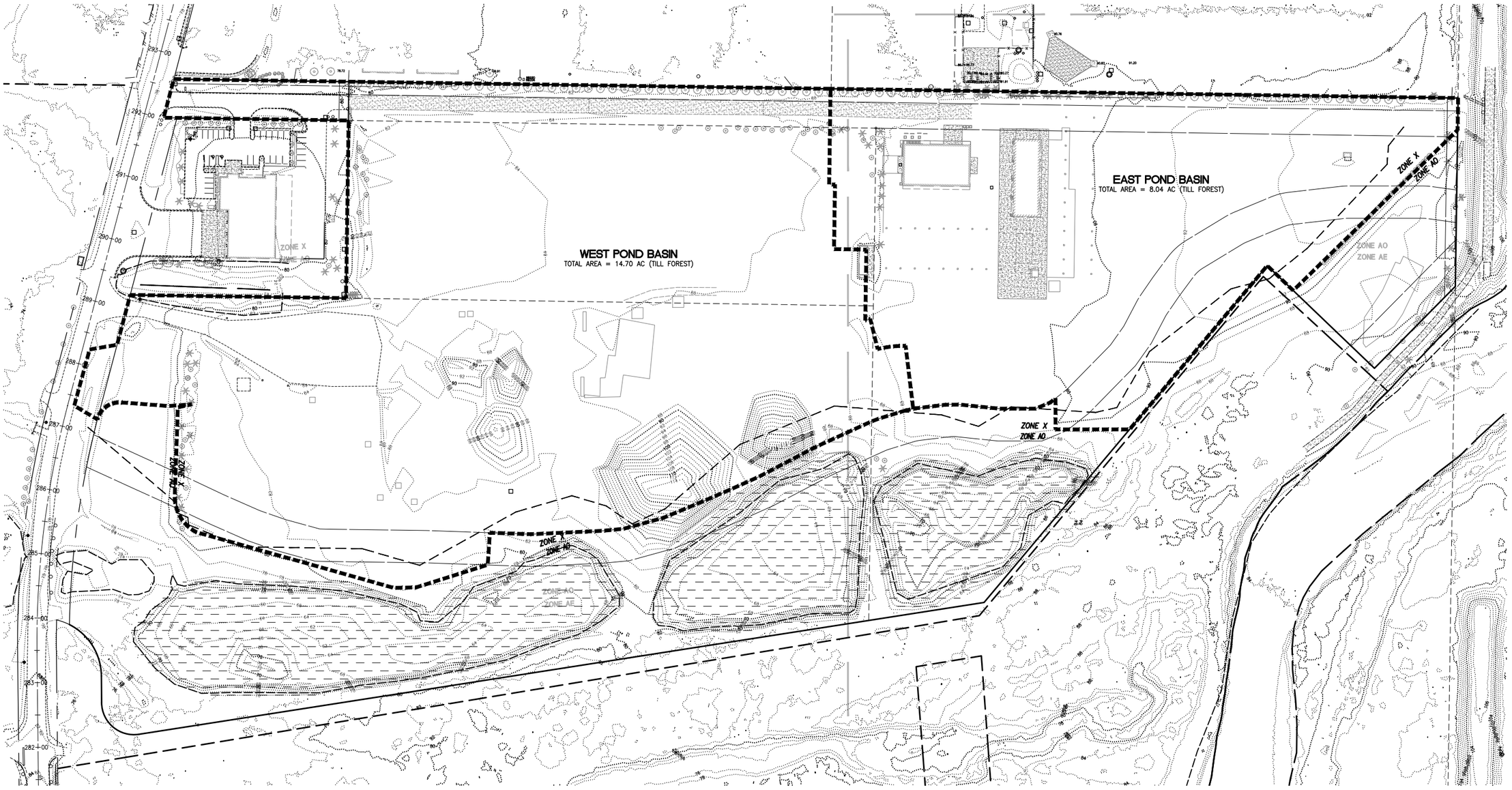
FOR

TOLT RIVER TERRACE

A PORTION OF NE 1/4 OF SECTION 21, TOWNSHIP 25N., RANGE 7 E., W.M.
CARNATION, WASHINGTON

1"=80'

0 40 80 160



No.	Revision	Date	By	Ckd.	Appr.

Title: PREDEVELOPED BASIN MAP FOR TOLT RIVER TERRACE

For: MAINVUE WA LLC.
11100 MAIN STREET, SUITE 100
BELLEVUE, WA 98004

BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH
KENT, WA 98032
(425) 251-6222
(425) 251-8782 FAX
CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES

Designed RAG
Drawn RAG
Checked RAG
Approved BJT
Date 5/3/19

Scale: Horizontal 1"=80' Vertical N/A

THATFIELD Xref: ----

Job Number 18057

Sheet 1 of 1

5.2 Developed Site Hydrology

The completed project will create 133 lots, the total developed area will be 23.52 acres in size. New impervious surfaces will include roadways, driveways, and roof areas. The project will be providing landscaped pervious areas, open space/park areas, and two drainage facilities. Under developed conditions, a conveyance system consisting of catch basins and storm pipe will be constructed in the roadways to collect stormwater from impervious surfaces and lots and convey to one of the new drainage facilities.

Stormwater from the east portion of the developed site will be collected and infiltrated onsite in at the East Infiltration Pond, located in Tract E, near the eastern edge of the site. Stormwater from the west portion of the developed site will be collected and detained onsite in at the West Detention Pond prior to being discharged to the westerly drainage course that flows to a tributary to the Snoqualmie River. Please note that the West Detention Pond is a combination detention & water quality pond. Flow control best management practices (BMPs), including infiltration and lot size reduction, will be incorporated into the drainage design to meet requirements for onsite flow control.

The west portion of the entry road in the northwest corner of the site is below the catch point of the stormwater conveyance system for the west detention pond. This area of the site, totaling 1.02 acres, was treated as bypass. Flow durations for target and proposed developed conditions at the point-of-compliance were evaluated using WWHM2012.

Conservation flow control standards are required based on the county's flow control applications map (King County Department of Natural Resources, 2015). Adopting these flow control standards will result in reduced flow rates from the site relative to existing conditions. Adopting conservation flow control standards will ensure that hydrologic conditions downstream from the site would not be degraded. Please refer to the Developed Basin Map (Figure 5.2.1), located within this section for a visualization of the overall basin areas. The total basin areas and surface area coverages for each basin are detailed in the tables below.

Developed Basins

The Developed Basin tributary to the West Detention Pond can be broken down as follows:

Impervious	Pervious	Total Area
10.64 Ac(1)	4.06 Ac(2)	14.70 Ac

Notes:
1. Roads and Sidewalks
   Lot Areas @ 65% Impervious
2. Till Grass

A detailed report on the procedures used for the sizing of the proposed combination detention & water quality pond is provided in Section 5.4 of this report.

The Developed Basin tributary to the East Infiltration Pond can be broken down as follows:

Impervious	Pervious	Total Area
5.62 Ac(1)	2.42 Ac(2)	8.04 Ac

Notes:
1. Roads and Sidewalks
   Lot Areas @ 65% Impervious
2. Till Grass

A detailed report on the procedures used for the sizing of the infiltration pond is provided in Section 5.4 of this report.

The Western Bypass Basin along the western edge of the site can be broken down as follows:

Impervious	Pervious	Total Area
0.51 Ac(1)	0.51 Ac(2)	1.02 Ac

Notes:
1. Roads and Sidewalks
2. Till Grass

For a detailed explanation on how the bypass basin affects the sizing of the west detention pond and the point of compliance for the site please reference Section 5.4 of this report.

Figure 5.2.1

Developed Basin Map

DEVELOPED BASIN MAP

FOR

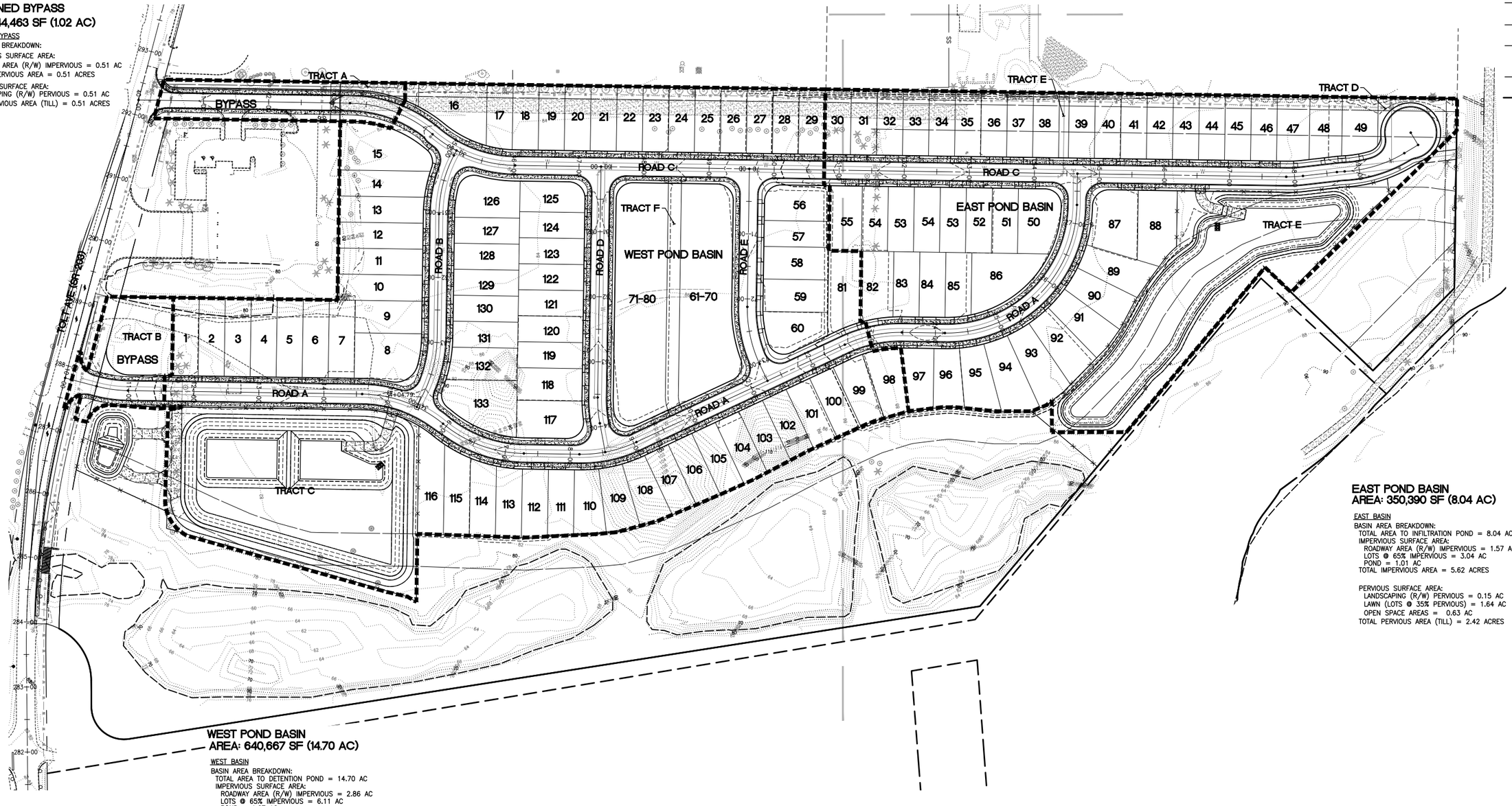
TOLT RIVER TERRACE

A PORTION OF NE 1/4 OF SECTION 21, TOWNSHIP 25N., RANGE 7 E., W.M.
CARNATION, WASHINGTON

1"=80'
0 40 80 160

COMBINED BYPASS
AREA: 44,463 SF (1.02 AC)

COMBINED BYPASS
BASIN AREA BREAKDOWN:
IMPERVIOUS SURFACE AREA:
ROADWAY AREA (R/W) IMPERVIOUS = 0.51 AC
TOTAL IMPERVIOUS AREA = 0.51 ACRES
PERVIOUS SURFACE AREA:
LANDSCAPING (R/W) PERVIOUS = 0.51 AC
TOTAL PERVIOUS AREA (TILL) = 0.51 ACRES



WEST POND BASIN
AREA: 640,667 SF (14.70 AC)

WEST BASIN
BASIN AREA BREAKDOWN:
TOTAL AREA TO DETENTION POND = 14.70 AC
IMPERVIOUS SURFACE AREA:
ROADWAY AREA (R/W) IMPERVIOUS = 2.86 AC
LOTS @ 65% IMPERVIOUS = 6.11 AC
POND = 1.67 AC
TOTAL IMPERVIOUS AREA = 10.64 ACRES
PERVIOUS SURFACE AREA:
LANDSCAPING (R/W) PERVIOUS = 0.30 AC
LAWN (LOTS @ 35% PERVIOUS) = 3.29 AC
OPEN SPACE AREAS = 0.47 AC
TOTAL PERVIOUS AREA (TILL) = 4.06 ACRES

EAST POND BASIN
AREA: 350,390 SF (8.04 AC)

EAST BASIN
BASIN AREA BREAKDOWN:
TOTAL AREA TO INFILTRATION POND = 8.04 AC
IMPERVIOUS SURFACE AREA:
ROADWAY AREA (R/W) IMPERVIOUS = 1.57 AC
LOTS @ 65% IMPERVIOUS = 3.04 AC
POND = 1.01 AC
TOTAL IMPERVIOUS AREA = 5.62 ACRES

PERVIOUS SURFACE AREA:
LANDSCAPING (R/W) PERVIOUS = 0.15 AC
LAWN (LOTS @ 35% PERVIOUS) = 1.64 AC
OPEN SPACE AREAS = 0.63 AC
TOTAL PERVIOUS AREA (TILL) = 2.42 ACRES

No.	Date	By	Ckd.	Appr.	Revision

Title: DEVELOPED BASIN MAP FOR TOLT RIVER TERRACE

For: MAINVUE WA LLC.
11100 MAIN STREET, SUITE 100
BELLEVUE, WA 98004

BARGHAUSEN CONSULTING ENGINEERS, INC.
18215 72ND AVENUE SOUTH
KENT, WA 98032
(425) 251-6222
(425) 251-8782 FAX
CIVIL ENGINEERING, LAND PLANNING, SURVEYING, ENVIRONMENTAL SERVICES

Scale: Horizontal 1"=80' Vertical N/A

Designed RAG Drawn RAG Checked RAG Approved BJT Date 5/15/19

THATFIELD Xref: -----

Scale:1" = 1' Date/Time:5/16/2019 10:23 AM File:P:\18000s\18057\exhibit\18057-pm20.dwg

Job Number 18057

Sheet 1 of 1

5.3 Performance Standards and Goals

The project is subject to the provisions of the City of Carnation's design standards and guidelines, as well as the 2012 Stormwater Management Manual for Western Washington (SWMMWW), as Amended in December 2014 , by the Washington State Department of Ecology. This report, along with the accompanying plans, are intended to satisfy the Stormwater Site Plan preparation requirements outlined in the regulatory documents listed above.

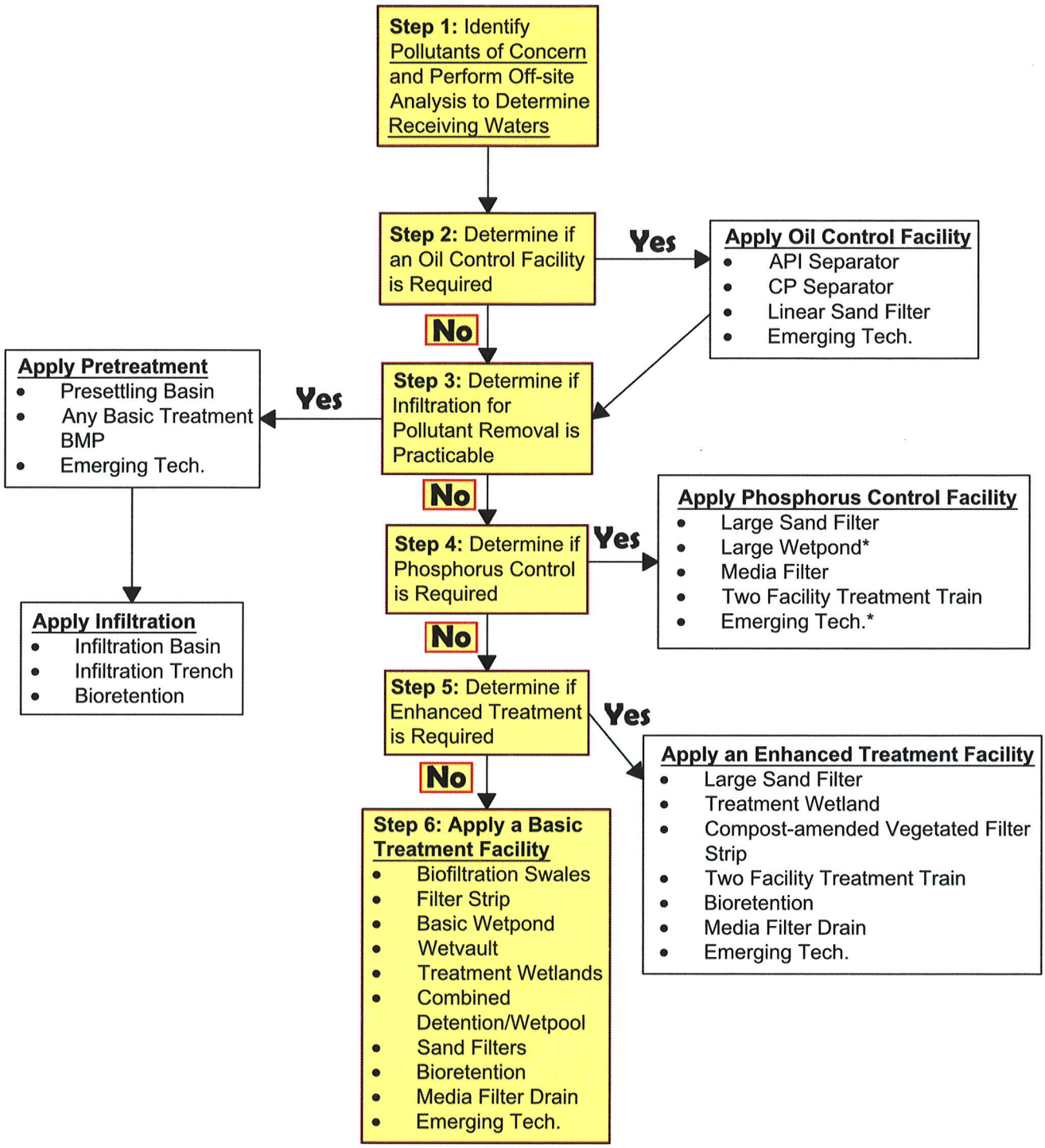
Hydrologic modeling was performed using the 2012 Western Washington Hydrology Model hence forth referred to as WWHM2012. WWHM2012 is a locally calibrated continuous simulation model developed by the Washington State Department of Ecology. The model evaluates several decades of hydrologic data to derive peak flow rate and duration information. Please reference, Section 5.5 - Flow Control, of this report for further information.

Water quality treatment will be provided by the cation exchange rate of the soils for the East Detention pond. The West Detention Pond is a combination detention and water quality pond. The type of water quality treatment being used for each pond was determined from the Treatment Facility Selection Flow Chart (Figures 5.3.1 & 5.3.2), located within this section of the report. Both facilities have been designed in compliance with Volume V of the 2012 SWMMWW. Please reference, Section 5.6 - Water Quality System, of this report for further information.

This project has opted to use the List #2 per the Flow Chart for Determining LID MR #5 Requirements (Figure 5.3.3), located within this section of the report. In order to meet the requirements for List #2 all individual on-site lots will have the following BMPs on top of the 65% maximum impervious surface coverage per lot. All soil in the lawn and landscaped areas for the site will be amended to meet the post-Construction Soil Quality and Depth requirement. Each individual lot will have a perforated stub-out connection for rooftops and have permeable pavement driveways. For more information on the LID Features for the project please reference Section 5.4 of this report.

Figure 5.3.1

West Detention Pond - Treatment Facility Selection Flow Chart



*When **Phosphorus Control and Enhanced** treatment are required, the Large Wetpond and certain types of emerging technologies will not meet both types of treatment requirements. A different or an additional treatment facility will be required to meet Enhanced treatment.

DEPARTMENT OF ECOLOGY
State of Washington

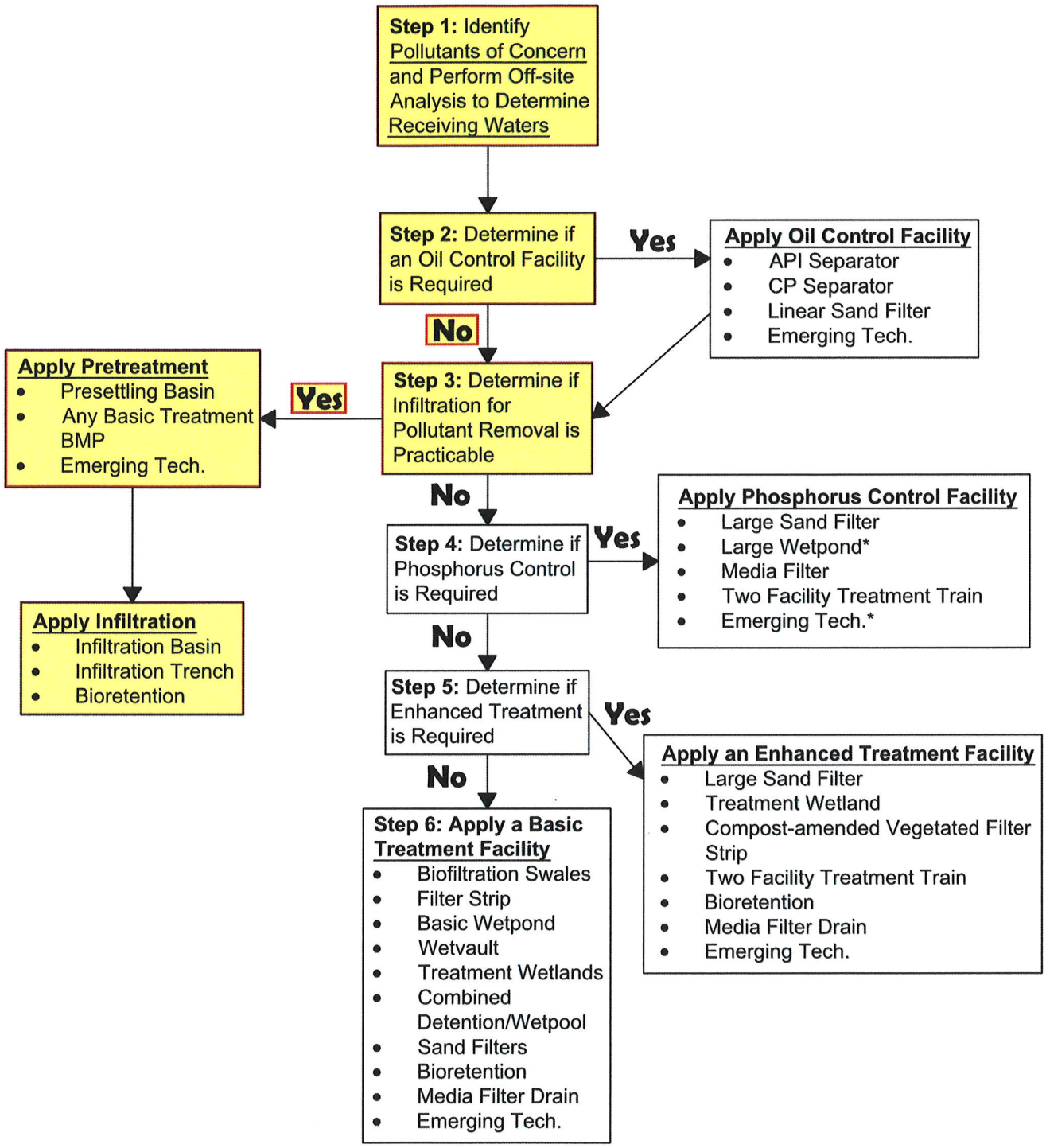
West Detention Pond

Figure V-2.1.1
Treatment Facility Selection Flow Chart

Revised December 2015

Figure 5.3.2

East Filtration Pond - Treatment Facility Selection Flow Chart



*When **Phosphorus Control and Enhanced** treatment are required, the Large Wetpond and certain types of emerging technologies will not meet both types of treatment requirements. A different or an additional treatment facility will be required to meet Enhanced treatment.

DEPARTMENT OF ECOLOGY
State of Washington

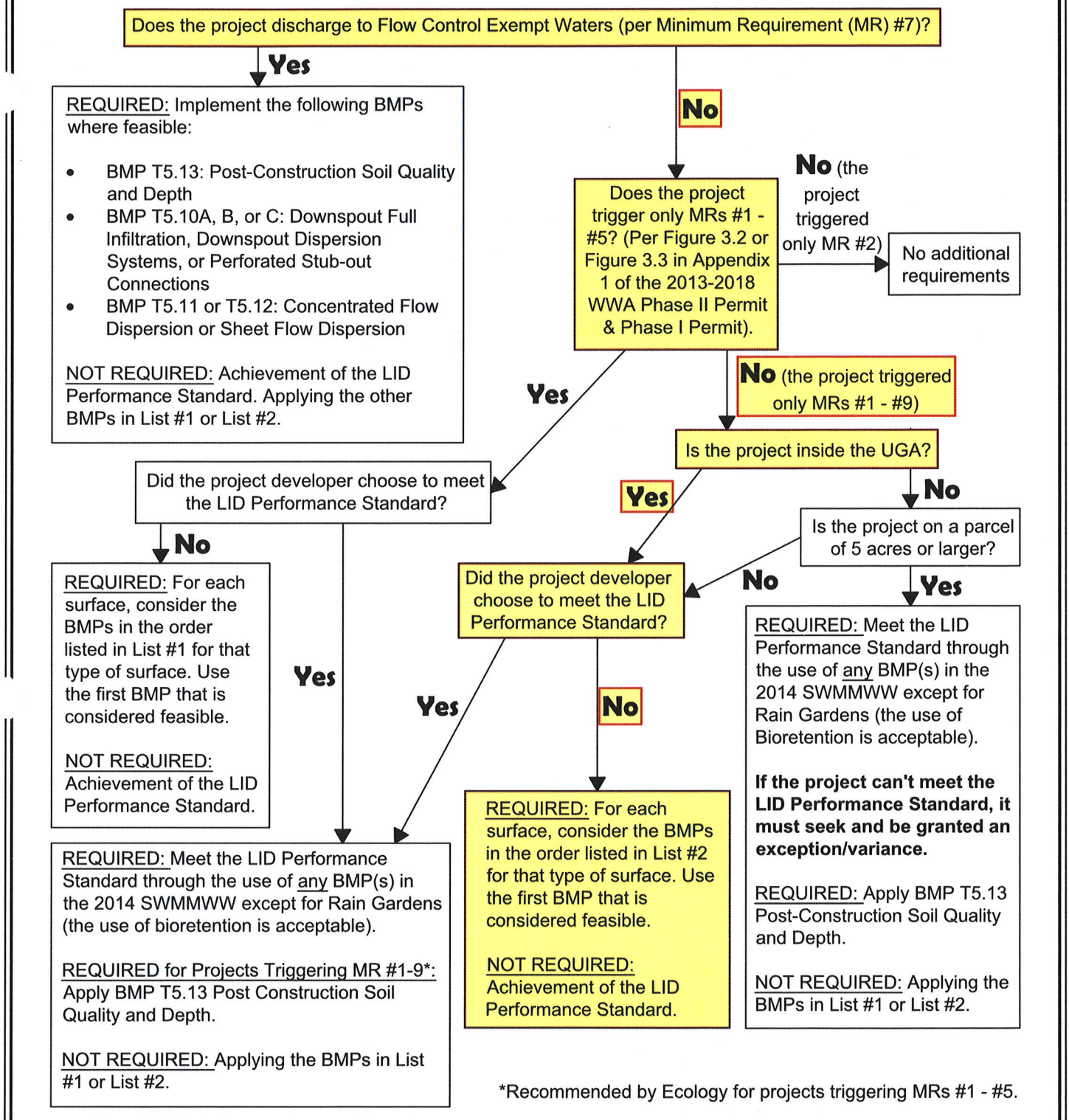
East Infiltration Pond

Figure V-2.1.1
Treatment Facility Selection Flow Chart

Revised December 2015

Figure 5.3.3

Flow Chart for
Determining LID
MR#5 Requirements



DEPARTMENT OF ECOLOGY
State of Washington

Figure I-2.5.1
Flow Chart for Determining LID MR #5 Requirements

Revised June 2015

5.4 Low Impact Development Features

This project has opted to use the List #2 per the Flow Chart for Determining LID MR #5 Requirements (Figure 5.3.3), located within Section 5.3 of this report. In order to meet the requirements for List #2 all individual on-site lots will have the following BMPs on top of the 65% maximum impervious surface coverage per lot. All soil in the lawn and landscaped areas for the site will be amended to meet BMP T5.13 Post-Construction Soil Quality and Depth.

Additionally each individual lot will have a Perforated Stub-Out Connection in compliance with BMP T5.10C, for all rooftop areas. Driveway areas for each lot are to be Permeable Pavement in accordance with BMP T5.15. Due to lot configurations and size Full Dispersion and Downspout Dispersion Systems for rooftop runoff is not possible. The use of Bioretention systems is also inhibited by the lot configurations and size. Due to the mass grading of the site including large quantities of cut and compacted fill Full Infiltration on the individual lot areas is not feasible.

However, soils near the eastern boundary of the site have been proven to be suitable for infiltration according to the Stormwater Infiltration Evaluation by The Riley Group, Inc. dated January 23, 2017, located in Section 7.0 of this report. The East Infiltration Pond is to be located in this area and will collected and infiltrate all stormwater runoff from the eastern half of the site. For details on the sizing of the East Infiltration Pond please reference Section 5.5 of this report.

Flow Control for the West Detention Pond is provided by matching developed discharge durations to forested durations for the range of pre-developed discharge rates from 50 percent of the two-year peak flow up to the full 50-year peak flow. As required by the 2012 SWMMWW. For details on the sizing of the West Detention Pond please reference Section 5.5 of this report.

5.5 Flow Control System

Surface runoff from the site will be routed to one of the two open stormwater ponds located On-Site. A detailed breakdown of the developed basin areas for each pond can be located in Section 5.2 of this report.

The stormwater pond sizing for the West Detention Pond was prepared by Ed McCarthy P.E., P.S. who has a PhD in Water Resources Engineering and over 25 years of experience consulting within the field of Water Resources Engineering on the effects of residential and commercial development. For full details and sizing calculations for the West Detention Pond please reference the Technical Memorandum, Yarington Development - Stormwater Pond Sizing by Ed McCarthy Ph.D., P.E. dated January 20, 2017, located within Section 5.5.2 of this report.

The east infiltration pond was sized using WWHM2012 to infiltrate runoff for up to the 100-year storm using a field-measured infiltration rate of 2.8 inches per hour. The exact processes for determining the infiltration rate can be found in the Stormwater Infiltration Evaluation by The Riley Group, Inc. dated January 23, 2017, located in Section 7.2 of this report. The following assumptions were used in sizing the east infiltration pond:

- A live storage depth of 4.0 feet was used with 3:1 interior side slopes.
- The top of the pond berm is assumed to be above the 100-year flood elevation, such that flows from the river do not overtop the berm.

The required storage volume of the east infiltration pond was calculated to be 119,341 cubic feet to the top of the pond's overflow riser. This equates to 14,843 cubic feet of storage per developed acre draining to the pond. The pond was predicted to infiltrate the full runoff volume for up to the 100-year storm. Pease reference the East Infiltration Pond Sizing Calculations provided in Section 5.5.1 of this report for further information.

Detailed plans of the stormwater ponds and their associated facilities will be provided during Final Engineering Review.

Figure 5.5.1

East Filtration Pond Sizing Calculations

EAST INFILTRATION POND

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	18057-East Infiltration Pond
Site Name:	
Site Address:	
City:	
Report Date:	11/20/2018
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.17
Version Date:	2015/11/13
Version:	4.2.11

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	8.04
Pervious Total	8.04
Impervious Land Use	acre
Impervious Total	0
Basin Total	8.04

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	2.42
Pervious Total	2.42

Impervious Land Use	acre
ROADS FLAT	5.62
Impervious Total	5.62
Basin Total	8.04

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length: 181.50 ft. Required Pond Bottom = 25,410 SF
Bottom Width: 140.00 ft.
Depth: 5 ft.
Volume at riser head: 2.7483 acre-feet. Required Volume = 119,716 CF
Infiltration On
Infiltration rate: 2.8 Inches Per Hour
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 1315.066
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 1315.066
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 4 ft.
Riser Diameter: 24 in.
Element Flows To:
Outlet 1 Outlet 2

Hydraulic Table

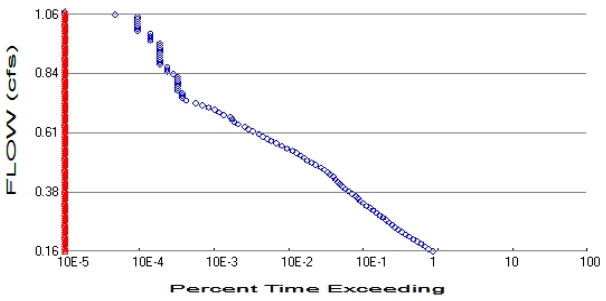
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.583	0.000	0.000	0.000
0.0556	0.585	0.032	0.000	1.646
0.1111	0.588	0.065	0.000	1.646
0.1667	0.590	0.097	0.000	1.646
0.2222	0.593	0.130	0.000	1.646
0.2778	0.595	0.163	0.000	1.646
0.3333	0.598	0.196	0.000	1.646
0.3889	0.600	0.230	0.000	1.646
0.4444	0.603	0.263	0.000	1.646
0.5000	0.605	0.297	0.000	1.646
0.5556	0.608	0.331	0.000	1.646
0.6111	0.610	0.364	0.000	1.646
0.6667	0.613	0.398	0.000	1.646
0.7222	0.615	0.432	0.000	1.646
0.7778	0.618	0.467	0.000	1.646
0.8333	0.620	0.501	0.000	1.646
0.8889	0.623	0.536	0.000	1.646
0.9444	0.625	0.570	0.000	1.646
1.0000	0.628	0.605	0.000	1.646
1.0556	0.631	0.640	0.000	1.646
1.1111	0.633	0.675	0.000	1.646
1.1667	0.636	0.711	0.000	1.646
1.2222	0.638	0.746	0.000	1.646
1.2778	0.641	0.782	0.000	1.646
1.3333	0.643	0.817	0.000	1.646
1.3889	0.646	0.853	0.000	1.646
1.4444	0.649	0.889	0.000	1.646

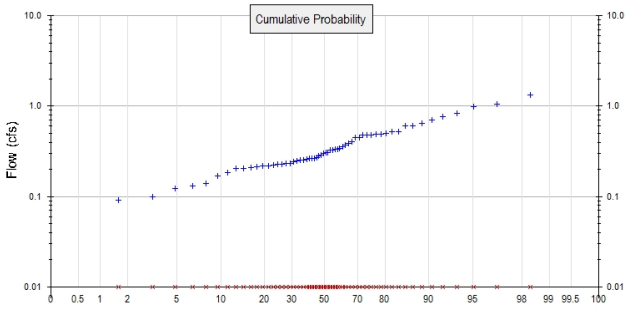
1.5000	0.651	0.925	0.000	1.646
1.5556	0.654	0.962	0.000	1.646
1.6111	0.656	0.998	0.000	1.646
1.6667	0.659	1.035	0.000	1.646
1.7222	0.662	1.071	0.000	1.646
1.7778	0.664	1.108	0.000	1.646
1.8333	0.667	1.145	0.000	1.646
1.8889	0.669	1.182	0.000	1.646
1.9444	0.672	1.220	0.000	1.646
2.0000	0.675	1.257	0.000	1.646
2.0556	0.677	1.295	0.000	1.646
2.1111	0.680	1.332	0.000	1.646
2.1667	0.683	1.370	0.000	1.646
2.2222	0.685	1.408	0.000	1.646
2.2778	0.688	1.446	0.000	1.646
2.3333	0.691	1.485	0.000	1.646
2.3889	0.693	1.523	0.000	1.646
2.4444	0.696	1.562	0.000	1.646
2.5000	0.699	1.601	0.000	1.646
2.5556	0.701	1.639	0.000	1.646
2.6111	0.704	1.679	0.000	1.646
2.6667	0.707	1.718	0.000	1.646
2.7222	0.710	1.757	0.000	1.646
2.7778	0.712	1.797	0.000	1.646
2.8333	0.715	1.836	0.000	1.646
2.8889	0.718	1.876	0.000	1.646
2.9444	0.720	1.916	0.000	1.646
3.0000	0.723	1.956	0.000	1.646
3.0556	0.726	1.997	0.000	1.646
3.1111	0.729	2.037	0.000	1.646
3.1667	0.731	2.078	0.000	1.646
3.2222	0.734	2.118	0.000	1.646
3.2778	0.737	2.159	0.000	1.646
3.3333	0.740	2.200	0.000	1.646
3.3889	0.742	2.241	0.000	1.646
3.4444	0.745	2.283	0.000	1.646
3.5000	0.748	2.324	0.000	1.646
3.5556	0.751	2.366	0.000	1.646
3.6111	0.754	2.408	0.000	1.646
3.6667	0.756	2.450	0.000	1.646
3.7222	0.759	2.492	0.000	1.646
3.7778	0.762	2.534	0.000	1.646
3.8333	0.765	2.577	0.000	1.646
3.8889	0.768	2.619	0.000	1.646
3.9444	0.770	2.662	0.000	1.646
4.0000	0.773	2.705	0.000	1.646
4.0556	0.776	2.748	0.277	1.646
4.1111	0.779	2.791	0.784	1.646
4.1667	0.782	2.834	1.438	1.646
4.2222	0.785	2.878	2.205	1.646
4.2778	0.787	2.922	3.059	1.646
4.3333	0.790	2.966	3.979	1.646
4.3889	0.793	3.010	4.939	1.646
4.4444	0.796	3.054	5.917	1.646
4.5000	0.799	3.098	6.887	1.646
4.5556	0.802	3.143	7.826	1.646
4.6111	0.805	3.187	8.711	1.646
4.6667	0.808	3.232	9.523	1.646

4.7222	0.810	3.277	10.24	1.646
4.7778	0.813	3.322	10.86	1.646
4.8333	0.816	3.367	11.38	1.646
4.8889	0.819	3.413	11.81	1.646
4.9444	0.822	3.458	12.16	1.646
5.0000	0.825	3.504	12.46	1.646
5.0556	0.828	3.550	12.94	1.646

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 8.04
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 2.42
Total Impervious Area: 5.62

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.314086
5 year	0.517823
10 year	0.672482
25 year	0.88862
50 year	1.063907
100 year	1.25093

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.384	0.000
1950	0.449	0.000
1951	0.646	0.000
1952	0.216	0.000
1953	0.182	0.000
1954	0.264	0.000
1955	0.408	0.000
1956	0.332	0.000
1957	0.300	0.000
1958	0.304	0.000

1959	0.259	0.000
1960	0.501	0.000
1961	0.251	0.000
1962	0.170	0.000
1963	0.245	0.000
1964	0.308	0.000
1965	0.229	0.000
1966	0.203	0.000
1967	0.477	0.000
1968	0.279	0.000
1969	0.269	0.000
1970	0.226	0.000
1971	0.286	0.000
1972	0.493	0.000
1973	0.233	0.000
1974	0.262	0.000
1975	0.374	0.000
1976	0.266	0.000
1977	0.092	0.000
1978	0.223	0.000
1979	0.139	0.000
1980	0.703	0.000
1981	0.205	0.000
1982	0.488	0.000
1983	0.335	0.000
1984	0.212	0.000
1985	0.124	0.000
1986	0.525	0.000
1987	0.483	0.000
1988	0.207	0.000
1989	0.130	0.000
1990	1.345	0.000
1991	0.606	0.000
1992	0.253	0.000
1993	0.245	0.000
1994	0.100	0.000
1995	0.326	0.000
1996	0.767	0.000
1997	0.606	0.000
1998	0.216	0.000
1999	0.838	0.000
2000	0.234	0.000
2001	0.061	0.000
2002	0.326	0.000
2003	0.447	0.000
2004	0.518	0.000
2005	0.341	0.000
2006	0.353	0.000
2007	0.995	0.000
2008	1.057	0.000
2009	0.476	0.000

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.3452	0.0000
2	1.0573	0.0000
3	0.9949	0.0000

4	0.8378	0.0000
5	0.7670	0.0000
6	0.7029	0.0000
7	0.6458	0.0000
8	0.6063	0.0000
9	0.6056	0.0000
10	0.5251	0.0000
11	0.5183	0.0000
12	0.5013	0.0000
13	0.4933	0.0000
14	0.4879	0.0000
15	0.4826	0.0000
16	0.4772	0.0000
17	0.4760	0.0000
18	0.4489	0.0000
19	0.4472	0.0000
20	0.4075	0.0000
21	0.3844	0.0000
22	0.3740	0.0000
23	0.3528	0.0000
24	0.3405	0.0000
25	0.3352	0.0000
26	0.3320	0.0000
27	0.3264	0.0000
28	0.3261	0.0000
29	0.3076	0.0000
30	0.3043	0.0000
31	0.2999	0.0000
32	0.2863	0.0000
33	0.2790	0.0000
34	0.2693	0.0000
35	0.2662	0.0000
36	0.2641	0.0000
37	0.2625	0.0000
38	0.2586	0.0000
39	0.2530	0.0000
40	0.2506	0.0000
41	0.2454	0.0000
42	0.2445	0.0000
43	0.2339	0.0000
44	0.2330	0.0000
45	0.2291	0.0000
46	0.2260	0.0000
47	0.2235	0.0000
48	0.2163	0.0000
49	0.2159	0.0000
50	0.2118	0.0000
51	0.2075	0.0000
52	0.2048	0.0000
53	0.2035	0.0000
54	0.1824	0.0000
55	0.1700	0.0000
56	0.1391	0.0000
57	0.1298	0.0000
58	0.1240	0.0000
59	0.0998	0.0000
60	0.0917	0.0000
61	0.0609	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1570	18454	0	0	Pass
0.1662	16129	0	0	Pass
0.1754	14378	0	0	Pass
0.1845	12763	0	0	Pass
0.1937	11263	0	0	Pass
0.2028	10004	0	0	Pass
0.2120	8812	0	0	Pass
0.2212	7856	0	0	Pass
0.2303	7024	0	0	Pass
0.2395	6320	0	0	Pass
0.2486	5713	0	0	Pass
0.2578	5219	0	0	Pass
0.2670	4740	0	0	Pass
0.2761	4280	0	0	Pass
0.2853	3916	0	0	Pass
0.2944	3538	0	0	Pass
0.3036	3204	0	0	Pass
0.3128	2896	0	0	Pass
0.3219	2627	0	0	Pass
0.3311	2353	0	0	Pass
0.3402	2143	0	0	Pass
0.3494	1960	0	0	Pass
0.3586	1804	0	0	Pass
0.3677	1673	0	0	Pass
0.3769	1528	0	0	Pass
0.3860	1343	0	0	Pass
0.3952	1225	0	0	Pass
0.4044	1125	0	0	Pass
0.4135	1045	0	0	Pass
0.4227	975	0	0	Pass
0.4319	911	0	0	Pass
0.4410	838	0	0	Pass
0.4502	766	0	0	Pass
0.4593	705	0	0	Pass
0.4685	637	0	0	Pass
0.4777	573	0	0	Pass
0.4868	491	0	0	Pass
0.4960	432	0	0	Pass
0.5051	376	0	0	Pass
0.5143	342	0	0	Pass
0.5235	309	0	0	Pass
0.5326	271	0	0	Pass
0.5418	239	0	0	Pass
0.5509	201	0	0	Pass
0.5601	171	0	0	Pass
0.5693	145	0	0	Pass
0.5784	125	0	0	Pass
0.5876	110	0	0	Pass
0.5967	96	0	0	Pass
0.6059	85	0	0	Pass
0.6151	71	0	0	Pass
0.6242	61	0	0	Pass
0.6334	55	0	0	Pass

0.6425	45	0	0	Pass
0.6517	40	0	0	Pass
0.6609	37	0	0	Pass
0.6700	35	0	0	Pass
0.6792	29	0	0	Pass
0.6883	25	0	0	Pass
0.6975	22	0	0	Pass
0.7067	18	0	0	Pass
0.7158	15	0	0	Pass
0.7250	12	0	0	Pass
0.7341	9	0	0	Pass
0.7433	8	0	0	Pass
0.7525	8	0	0	Pass
0.7616	8	0	0	Pass
0.7708	7	0	0	Pass
0.7799	7	0	0	Pass
0.7891	7	0	0	Pass
0.7983	7	0	0	Pass
0.8074	7	0	0	Pass
0.8166	7	0	0	Pass
0.8257	7	0	0	Pass
0.8349	6	0	0	Pass
0.8441	5	0	0	Pass
0.8532	5	0	0	Pass
0.8624	5	0	0	Pass
0.8715	4	0	0	Pass
0.8807	4	0	0	Pass
0.8899	4	0	0	Pass
0.8990	4	0	0	Pass
0.9082	4	0	0	Pass
0.9173	4	0	0	Pass
0.9265	4	0	0	Pass
0.9357	4	0	0	Pass
0.9448	4	0	0	Pass
0.9540	4	0	0	Pass
0.9631	3	0	0	Pass
0.9723	3	0	0	Pass
0.9815	3	0	0	Pass
0.9906	3	0	0	Pass
0.9998	2	0	0	Pass
1.0089	2	0	0	Pass
1.0181	2	0	0	Pass
1.0273	2	0	0	Pass
1.0364	2	0	0	Pass
1.0456	2	0	0	Pass
1.0547	2	0	0	Pass
1.0639	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Trapezoidal Pond 1 POC	☐	1196.73			☐	100.00			
Total Volume Infiltrated		1196.73	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

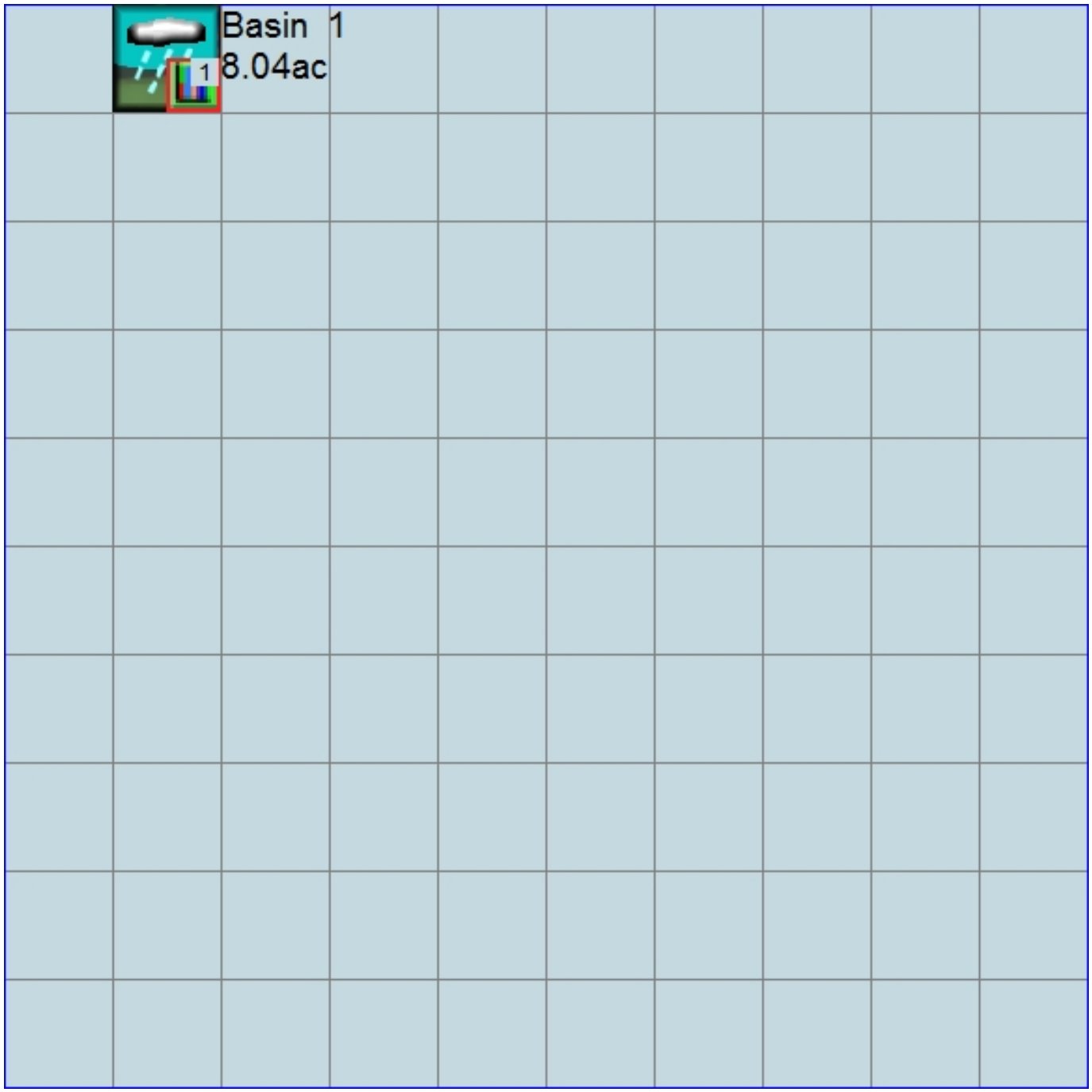
No PERLND changes have been made.

IMPLND Changes

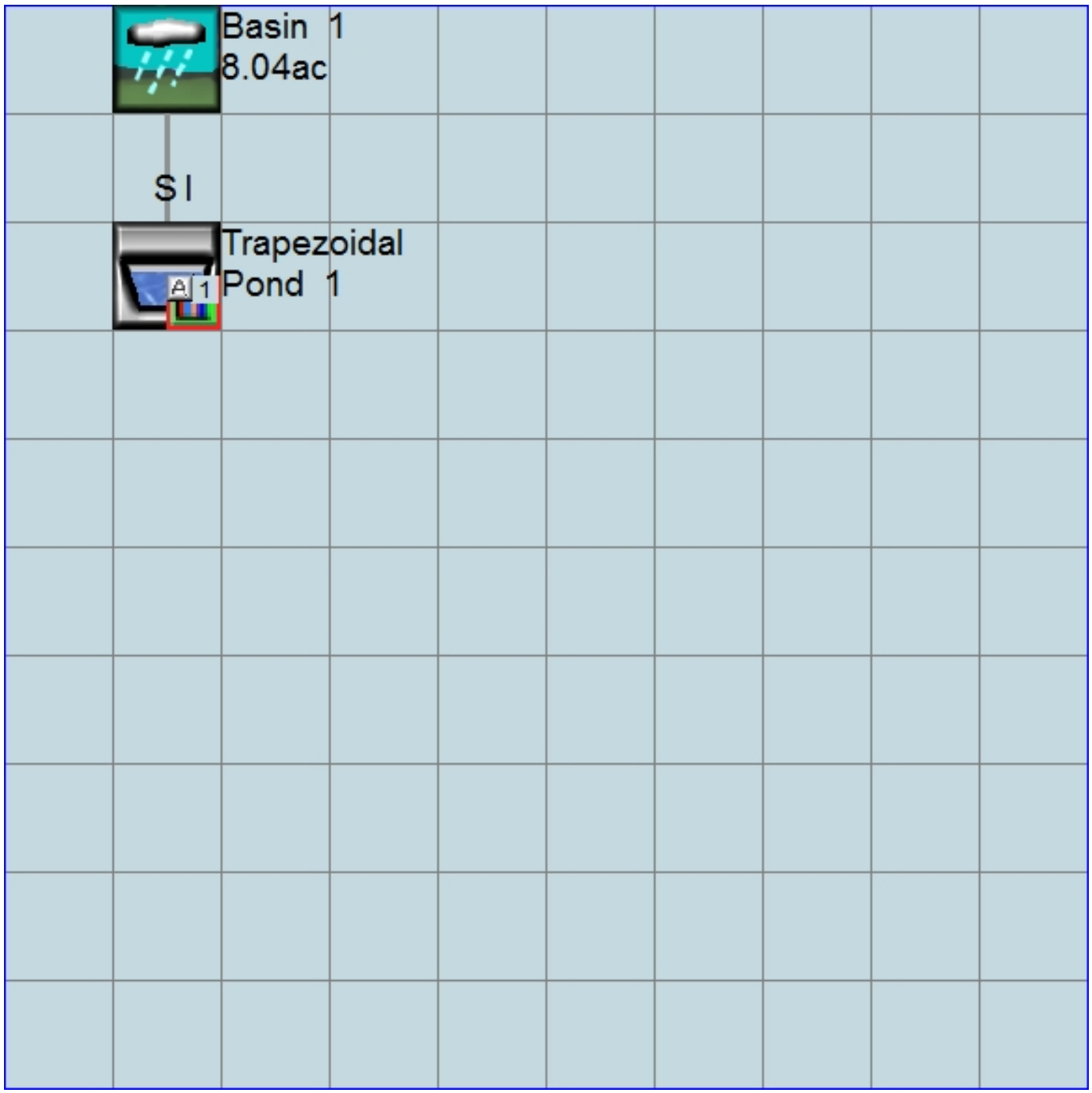
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18057-East Infiltration Pond.wdm
MESSU       25   Pre18057-East Infiltration Pond.MES
            27   Pre18057-East Infiltration Pond.L61
            28   Pre18057-East Infiltration Pond.L62
            30   POC18057-East Infiltration Pond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10             0       4.5      0.08       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10           0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                       8.04     COPY   501     12
PERLND  10                       8.04     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *      *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><--------> ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><---><---><---><---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.167          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.167          IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   18057-East Infiltration Pond.wdm
MESSU       25   Mit18057-East Infiltration Pond.MES
            27   Mit18057-East Infiltration Pond.L61
            28   Mit18057-East Infiltration Pond.L62
            30   POC18057-East Infiltration Pond1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                      in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
```

```
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16             0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16           0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS       GWVS
   16             0         0         0         0       2.5         1          0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                  in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
```

```
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                        2.42     RCHRES   1      2
PERLND  16                        2.42     RCHRES   1      3
IMPLND   1                        5.62     RCHRES   1      5

******Routing******
PERLND  16                        2.42     COPY     1     12
IMPLND   1                        5.62     COPY     1     15
PERLND  16                        2.42     COPY     1     13
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
    1     Trapezoidal Pond-005    2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                   ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->      ***
```

```
    1             1      0.03       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                    ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><--------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.583333  0.000000  0.000000  0.000000
  0.055556  0.585796  0.032476  0.000000  1.646944
  0.111111  0.588264  0.065089  0.000000  1.646944
  0.166667  0.590737  0.097839  0.000000  1.646944
  0.222222  0.593215  0.130726  0.000000  1.646944
  0.277778  0.595698  0.163752  0.000000  1.646944
  0.333333  0.598186  0.196915  0.000000  1.646944
  0.388889  0.600680  0.230217  0.000000  1.646944
  0.444444  0.603178  0.263657  0.000000  1.646944
  0.500000  0.605682  0.297237  0.000000  1.646944
  0.555556  0.608190  0.330955  0.000000  1.646944
  0.611111  0.610704  0.364814  0.000000  1.646944
  0.666667  0.613223  0.398812  0.000000  1.646944
  0.722222  0.615747  0.432950  0.000000  1.646944
  0.777778  0.618276  0.467228  0.000000  1.646944
  0.833333  0.620810  0.501647  0.000000  1.646944
  0.888889  0.623350  0.536207  0.000000  1.646944
  0.944444  0.625894  0.570908  0.000000  1.646944
  1.000000  0.628444  0.605751  0.000000  1.646944
  1.055556  0.630998  0.640736  0.000000  1.646944
  1.111111  0.633558  0.675862  0.000000  1.646944
  1.166667  0.636123  0.711131  0.000000  1.646944
  1.222222  0.638692  0.746543  0.000000  1.646944
  1.277778  0.641267  0.782097  0.000000  1.646944
  1.333333  0.643848  0.817795  0.000000  1.646944
  1.388889  0.646433  0.853636  0.000000  1.646944
  1.444444  0.649023  0.889621  0.000000  1.646944
  1.500000  0.651618  0.925750  0.000000  1.646944
  1.555556  0.654219  0.962023  0.000000  1.646944
  1.611111  0.656825  0.998441  0.000000  1.646944
  1.666667  0.659435  1.035004  0.000000  1.646944
  1.722222  0.662051  1.071711  0.000000  1.646944
  1.777778  0.664672  1.108565  0.000000  1.646944
  1.833333  0.667298  1.145564  0.000000  1.646944
  1.888889  0.669929  1.182709  0.000000  1.646944
  1.944444  0.672565  1.220001  0.000000  1.646944
  2.000000  0.675207  1.257439  0.000000  1.646944
  2.055556  0.677853  1.295024  0.000000  1.646944
  2.111111  0.680505  1.332756  0.000000  1.646944
  2.166667  0.683161  1.370636  0.000000  1.646944
  2.222222  0.685823  1.408663  0.000000  1.646944
  2.277778  0.688490  1.446838  0.000000  1.646944
  2.333333  0.691162  1.485162  0.000000  1.646944
  2.388889  0.693839  1.523634  0.000000  1.646944
  2.444444  0.696521  1.562255  0.000000  1.646944
  2.500000  0.699208  1.601026  0.000000  1.646944
  2.555556  0.701900  1.639945  0.000000  1.646944
  2.611111  0.704598  1.679015  0.000000  1.646944
  2.666667  0.707300  1.718234  0.000000  1.646944
  2.722222  0.710008  1.757604  0.000000  1.646944
  2.777778  0.712721  1.797124  0.000000  1.646944
  2.833333  0.715438  1.836795  0.000000  1.646944
```

```
  2.888889  0.718161  1.876617  0.000000  1.646944
  2.944444  0.720889  1.916591  0.000000  1.646944
  3.000000  0.723623  1.956716  0.000000  1.646944
  3.055556  0.726361  1.996993  0.000000  1.646944
  3.111111  0.729104  2.037423  0.000000  1.646944
  3.166667  0.731853  2.078005  0.000000  1.646944
  3.222222  0.734606  2.118740  0.000000  1.646944
  3.277778  0.737365  2.159628  0.000000  1.646944
  3.333333  0.740129  2.200670  0.000000  1.646944
  3.388889  0.742897  2.241865  0.000000  1.646944
  3.444444  0.745671  2.283214  0.000000  1.646944
  3.500000  0.748450  2.324717  0.000000  1.646944
  3.555556  0.751235  2.366375  0.000000  1.646944
  3.611111  0.754024  2.408188  0.000000  1.646944
  3.666667  0.756818  2.450156  0.000000  1.646944
  3.722222  0.759618  2.492279  0.000000  1.646944
  3.777778  0.762422  2.534558  0.000000  1.646944
  3.833333  0.765232  2.576993  0.000000  1.646944
  3.888889  0.768047  2.619584  0.000000  1.646944
  3.944444  0.770866  2.662331  0.000000  1.646944
  4.000000  0.773691  2.705236  0.000000  1.646944
  4.055556  0.776522  2.748297  0.277796  1.646944
  4.111111  0.779357  2.791516  0.784769  1.646944
  4.166667  0.782197  2.834893  1.438492  1.646944
  4.222222  0.785042  2.878427  2.205262  1.646944
  4.277778  0.787893  2.922120  3.059929  1.646944
  4.333333  0.790748  2.965971  3.979211  1.646944
  4.388889  0.793609  3.009981  4.939668  1.646944
  4.444444  0.796475  3.054150  5.917238  1.646944
  4.500000  0.799346  3.098478  6.887532  1.646944
  4.555556  0.802222  3.142966  7.826549  1.646944
  4.611111  0.805103  3.187614  8.711714  1.646944
  4.666667  0.807989  3.232422  9.523132  1.646944
  4.722222  0.810880  3.277391  10.24504  1.646944
  4.777778  0.813777  3.322520  10.86741  1.646944
  4.833333  0.816678  3.367811  11.38772  1.646944
  4.888889  0.819585  3.413262  11.81283  1.646944
  4.944444  0.822496  3.458876  12.16099  1.646944
  5.000000  0.825413  3.504651  12.46394  1.646944
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.167          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.167          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>           <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2
```

```
  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Figure 5.5.2

Technical Memorandum, Tolt River Terrace - Stormwater Pond Sizing - West Pond, prepared by Ed McCarthy P.E. P.S. dated December 1, 2018

Technical Memorandum

Re: Tolt River Terrace – Stormwater Pond Sizing – West Pond

Project: Tolt River Terrace
Project Location: Carnation, WA

Prepared by: Ed McCarthy, PE, PS
9957 171st Ave SE
Renton, WA 98059

Prepared for: Barghausen Consulting Engineers
18215 72nd Avenue South
Kent, WA 98032

Date: 12-1-18

Background Information

The Tolt River Terrace development is a proposed 133-lot single-family residential plat on 23.76 acres. The subject property is located at 3440 Tolt Avenue in Carnation, WA (Figure 1). The project site drains to a series of existing infiltration/detention ponds located in the floodplain of the Tolt River. These ponds are thought to have limited infiltration capacity in winter months due to high groundwater levels and effects of floodwater from the Tolt River. Floods with return periods of 3 to 5 years inundate the existing ponds on the site.

As part of the plat proposal, new stormwater ponds outside of the river's floodplain will be constructed. An infiltration pond will be constructed in the eastern portion of the site. A conventional detention pond will be constructed in the western portion of the site. The design of the west detention pond accounts for backwater effects that could potentially be created by flood levels in the Tolt River. The easterly infiltration pond is located at a higher elevation and is designed to infiltrate up to the 100-year storm for its tributary basin.

Methods

Site Hydrology

Under existing conditions, the site consists of a single threshold discharge area that drains to the west. Under proposed developed conditions, stormwater from the developed portion of the site will be managed in two stormwater ponds including the west detention pond and the east infiltration pond.

Data for target forested basin conditions (Table 1) and the proposed development (Table 2) were input to the Western Washington Hydrologic Model (WWHM2012 Version 4.2.13) to size the ponds. WWHM2012 is a continuous hydrologic model that develops runoff time series for a long-term period of rainfall record. SeaTac rainfall record with a scaling factor of 1.167 was used in the hydrologic modeling (Figure 2). A 15-minute time step was used in generating the runoff time series. WWHM2012 model inputs are provided in Appendix A for the west detention pond.

Tolt River Backwater Effects

The WWHM2012 program generates statistical reports for several hydrologic parameters including peak flow rates and stage for estimated return periods and flow durations. In addition, the model has the ability to import a time series that can be used to define a downstream boundary condition on the outlet of a proposed stormwater facility.

The tide gate option in WWHM2012 was used to define water levels in the Tolt River at River Station 9.0 (RS 9.0), the outlet location of the proposed west detention pond. Hourly flow data from USGS Gage 12148500 (Tolt River near Carnation) were obtained and used to create a time series for the available flow record extending from 1987 through 2009. These flow data were then used to generate a times series dating back to the full historic period of the model simulation.

A rating curve, that defined the river water elevation for a given flow rate, was developed using FEMA's hydraulic model of the Tolt River (Appendix A). This same hydraulic model was used to develop the Flood Insurance Rate Map for the Tolt River. The WWHM2012 model determines the flood stage in the Tolt River for each model time step by routing the river flow time series through a custom stage-storage-discharge table (SSD table) that represents the river's hydraulics at RS 9.0. The model then regulates flow out of the site's stormwater pond by comparing the river water elevation to the pond storage elevation for each time step. Flow from the pond does not occur when the river stage is higher than the pond water level. The downstream flow restriction caused by the river's backwater is therefore accounted for in the pond sizing when determining compliance with the required flow control standards.

Pond Designs

Flow control standards as prescribed in the 2014 *Stormwater Management Manual for Western Washington* were applied in designing the proposed stormwater ponds for the project. Flow control standards require that stormwater discharges match developed discharge durations to forested durations for the range of pre-developed discharge rates from 50 percent of the two-year peak flow up to the full 50-year peak flow.

The following assumptions were used in sizing the west detention pond:

- A live storage depth of 6.0 feet was used with 3:1 interior side slopes. The bottom of the pond's live storage is at elevation 74.0 NAVD 88.
- The pond outfall was assumed to be in the western portion of the site at approximately Tolt RS 9.0. This river station is 400 feet upstream from the SR 203 bridge. The estimated 100-year flood elevation at the discharge location was modeled to be 81.77 feet NAVD 88.
- The top of the pond berm is assumed to be above the 100-year flood elevation, such that flows from the river do not overtop the berm.
- The pond outfall assumes that there is a tide flex valve on the outlet pipe to prevent river flood water from flowing onto the pond.

The east infiltration pond was sized using WWHM2012 to infiltrate runoff for up to the 100-year storm using a field-measured infiltration rate.

The west portion of the entry road in the northwest corner of the site is below the catch point of the stormwater conveyance system for the west detention pond. This area of the site, totaling 1.02 acres, was treated as bypass in the design of the west pond. Flow durations for target and proposed developed conditions at the point-of-compliance were evaluated using WWHM2012.

Results

West Detention Pond

The required storage volume of the west detention pond was calculated to be 213,139 cubic feet to the top of the pond's overflow riser (Appendix A). Stormwater from the west basin will be treated in a basic wetpond. The online 24-hour water quality volume for stormwater inflows to the west detention pond was calculated to be 73,107 cubic feet.

East Infiltration Pond

The east pond is designed to infiltrate runoff volumes for up to the 100-year storm.

Point-of-Compliance Analysis

The flow durations from the areas of bypass and the outflow from the west detention pond were predicted to be less than the durations from the site under target forested conditions (Appendix A). Discharge from the site's easterly basin under developed conditions is not included in the point-of-compliance flow durations because stormwater collected in the east basin is infiltrated for storms up to the 100-year event.

Edward J. McCarthy, Ph.D., P.E.

References

Barghausen Consulting Engineers, November 20, 2018. Developed Basin Map for Tolt River Terrace. Kent, Wash.

Clear Creek Solutions, 2012. Western Washington Hydrology Model Version 2014/5/28. Olympia, Wash.

Table 1. Site under target forested conditions.

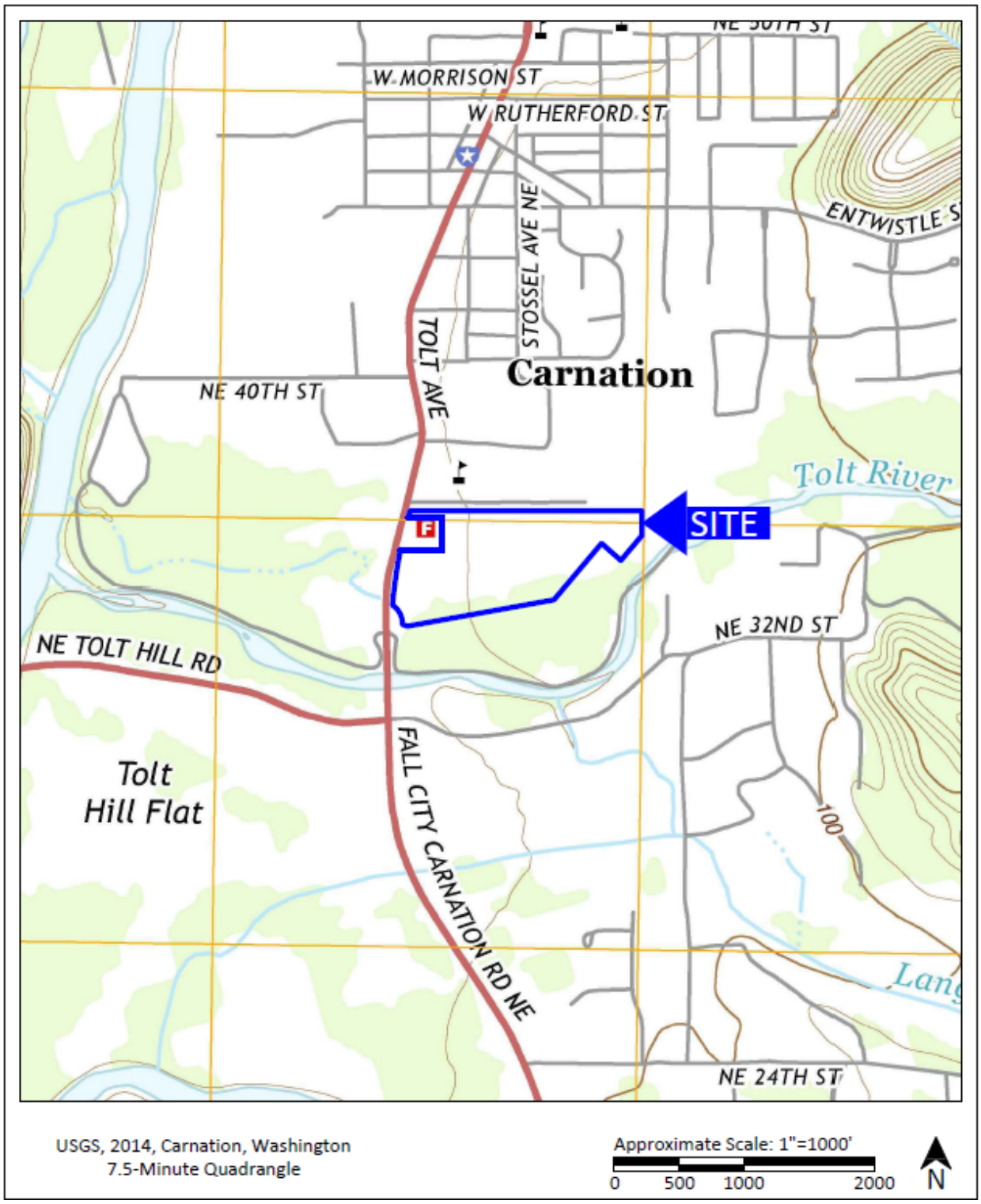
Basin	Forest	Total
Total Project Area	23.76	23.76
Total	23.76	23.76

Table 2. Basins under post-project conditions.

West Pond	Landscape (AC)	Imperv. (AC)	Total (AC)
Tributary Area to Pond	4.06	10.64	14.70
Bypass	0.51	0.51	1.02
Total	4.57	11.15	15.72

East Pond	Landscape (AC)	Imperv. (AC)	Total (AC)
Tributary Area to Pond	2.42	5.62	8.04
Total	2.42	5.62	8.04

Figure 1. Vicinity Map.



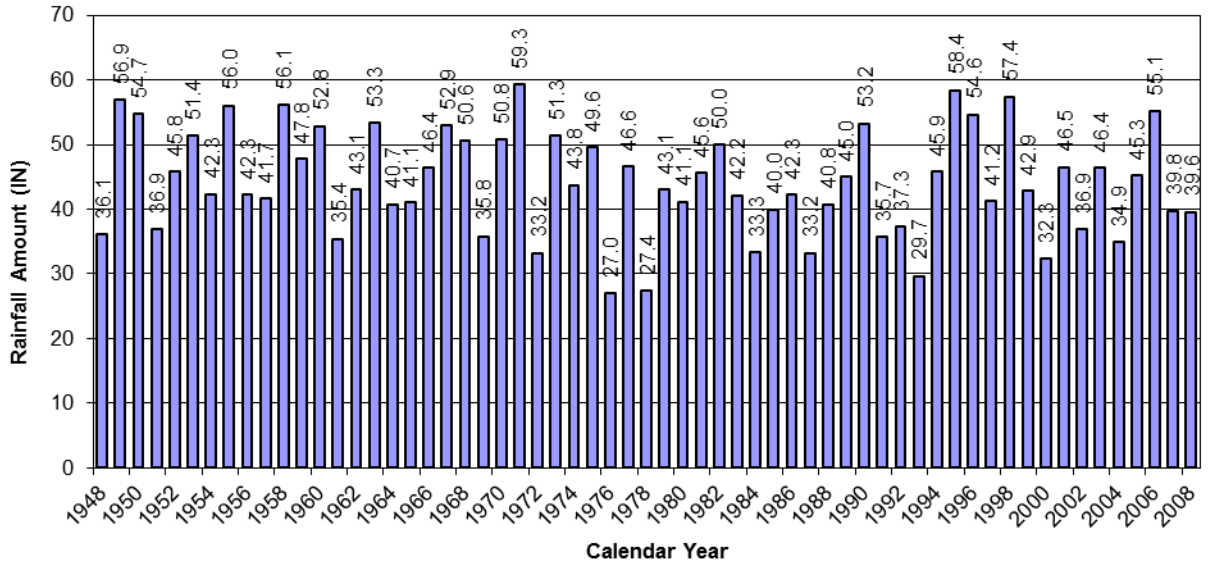
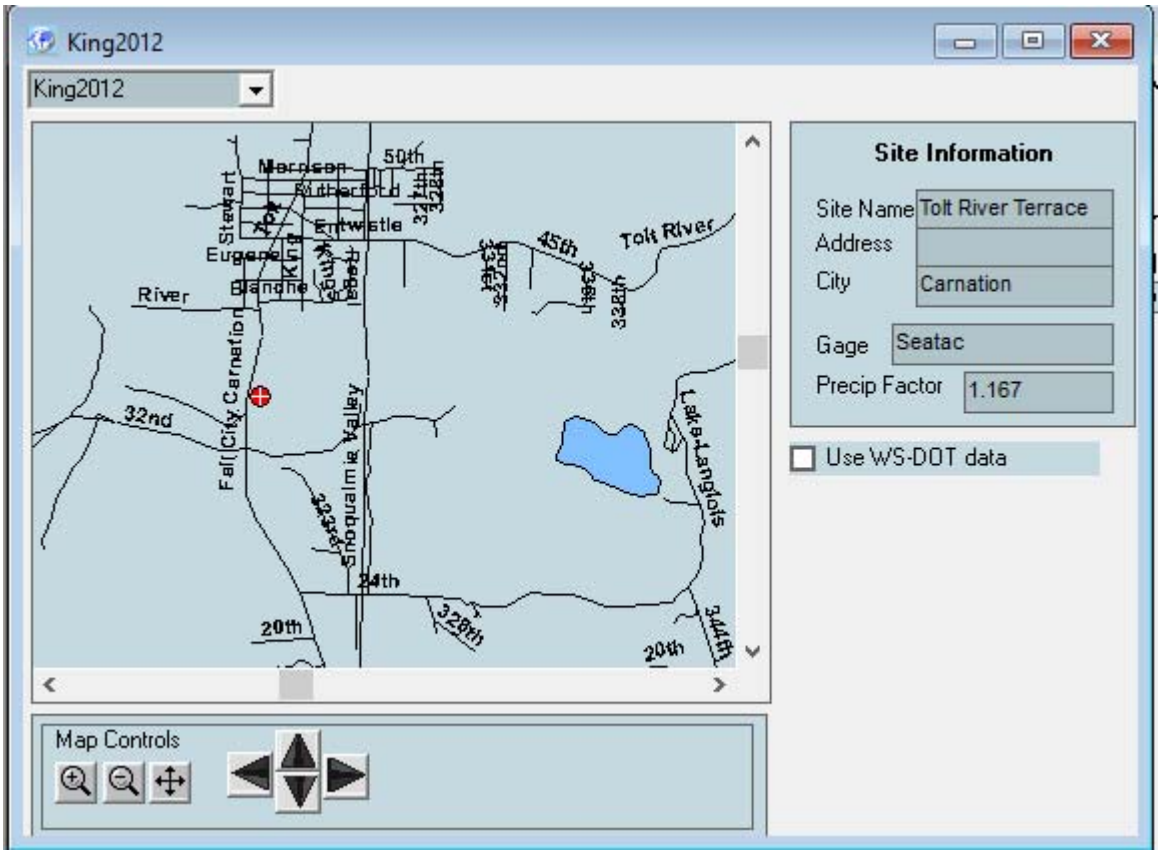


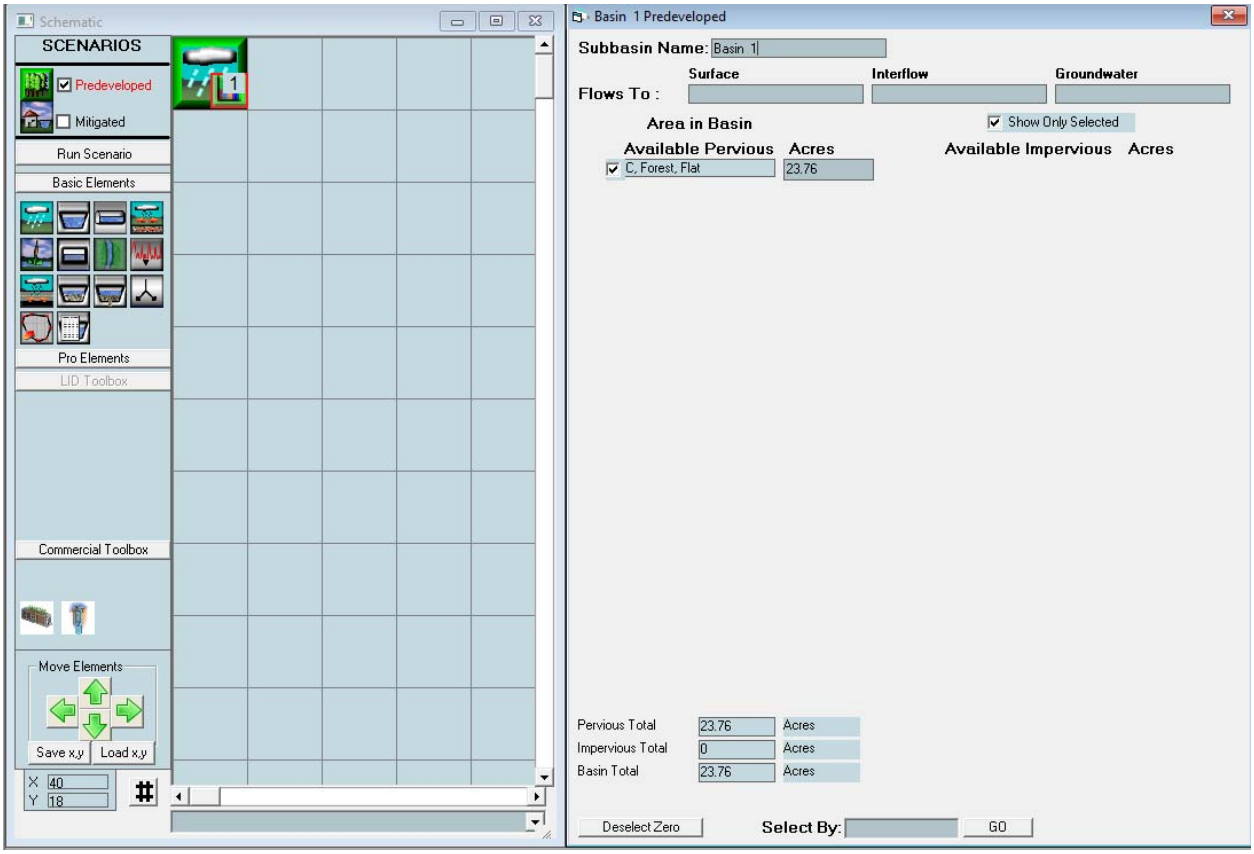
Figure 2. Annual rainfall amounts used in hydrologic model for the pond designs. These values were scaled by a factor of 1.167.

Appendix A. WWHM2012 West Pond Design

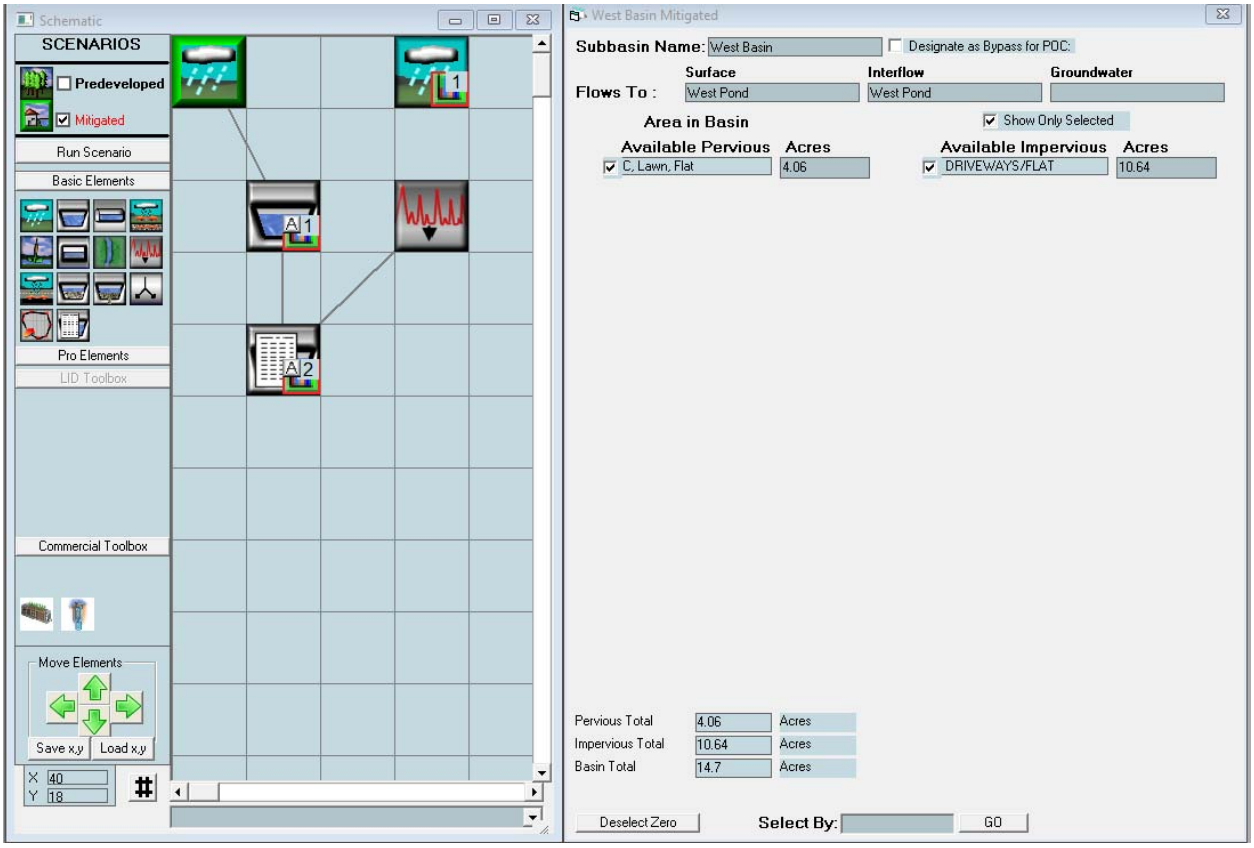
Project Location and Precipitation Record



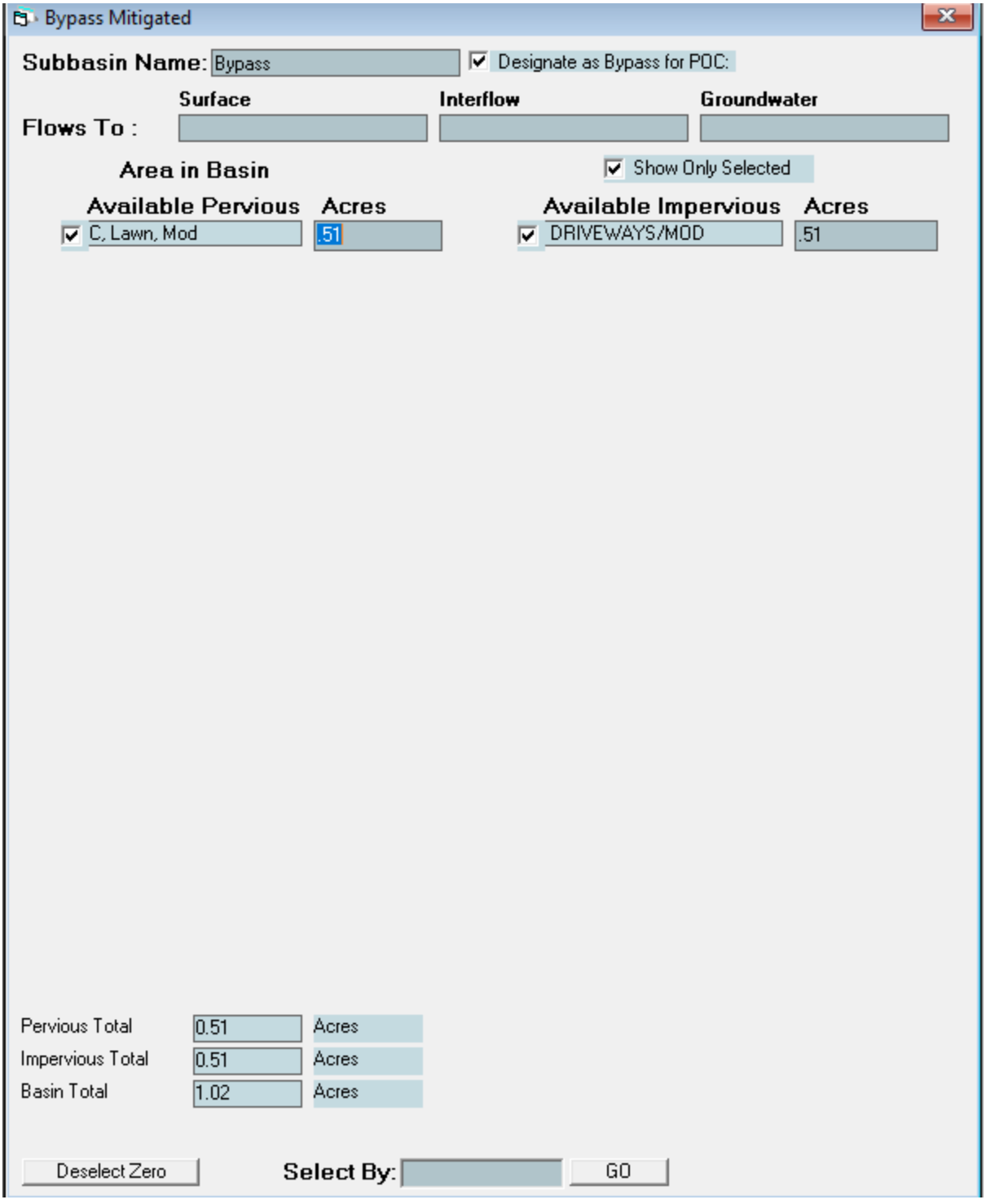
Project Site – Forested Conditions



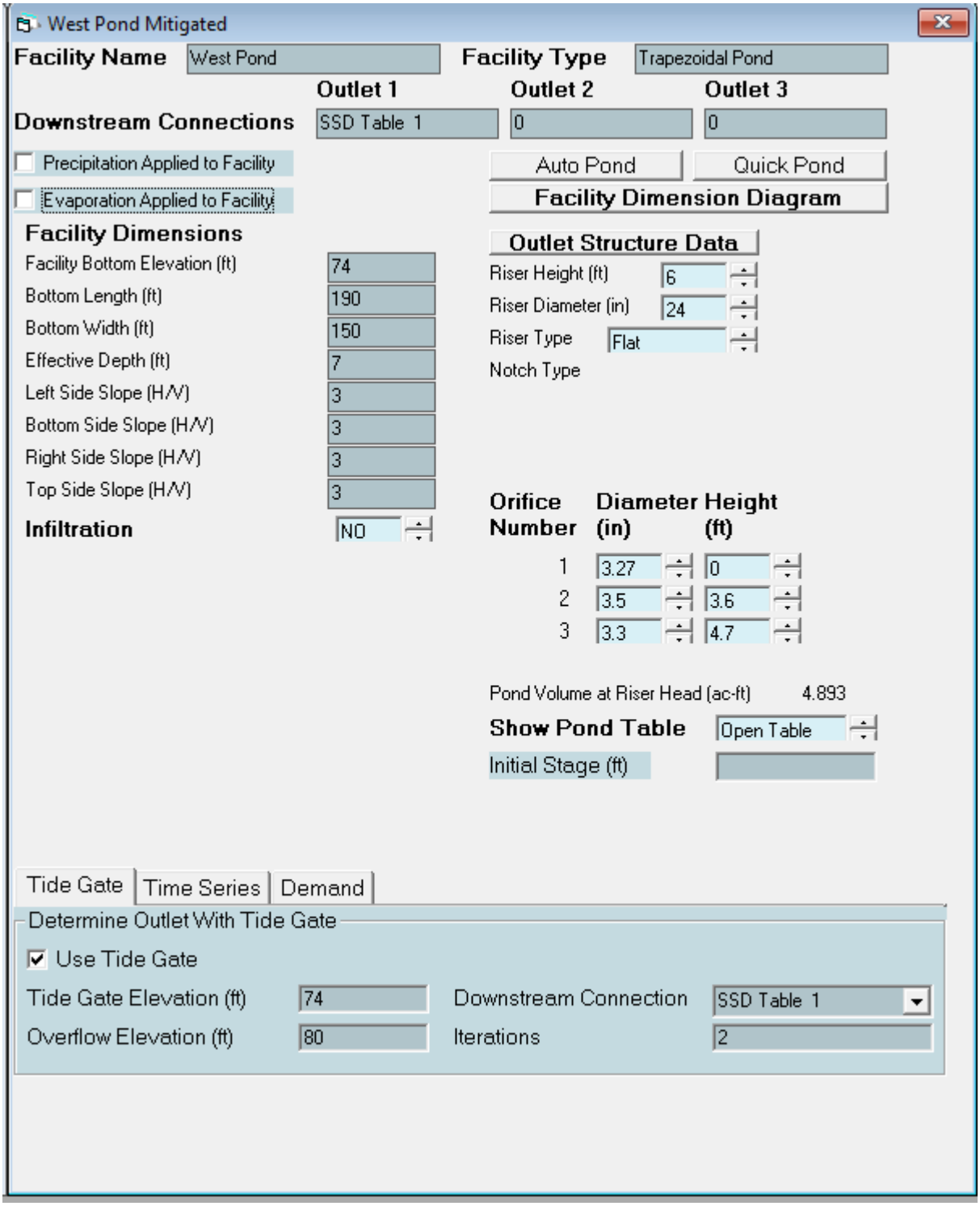
West Basin – Post-project Conditions



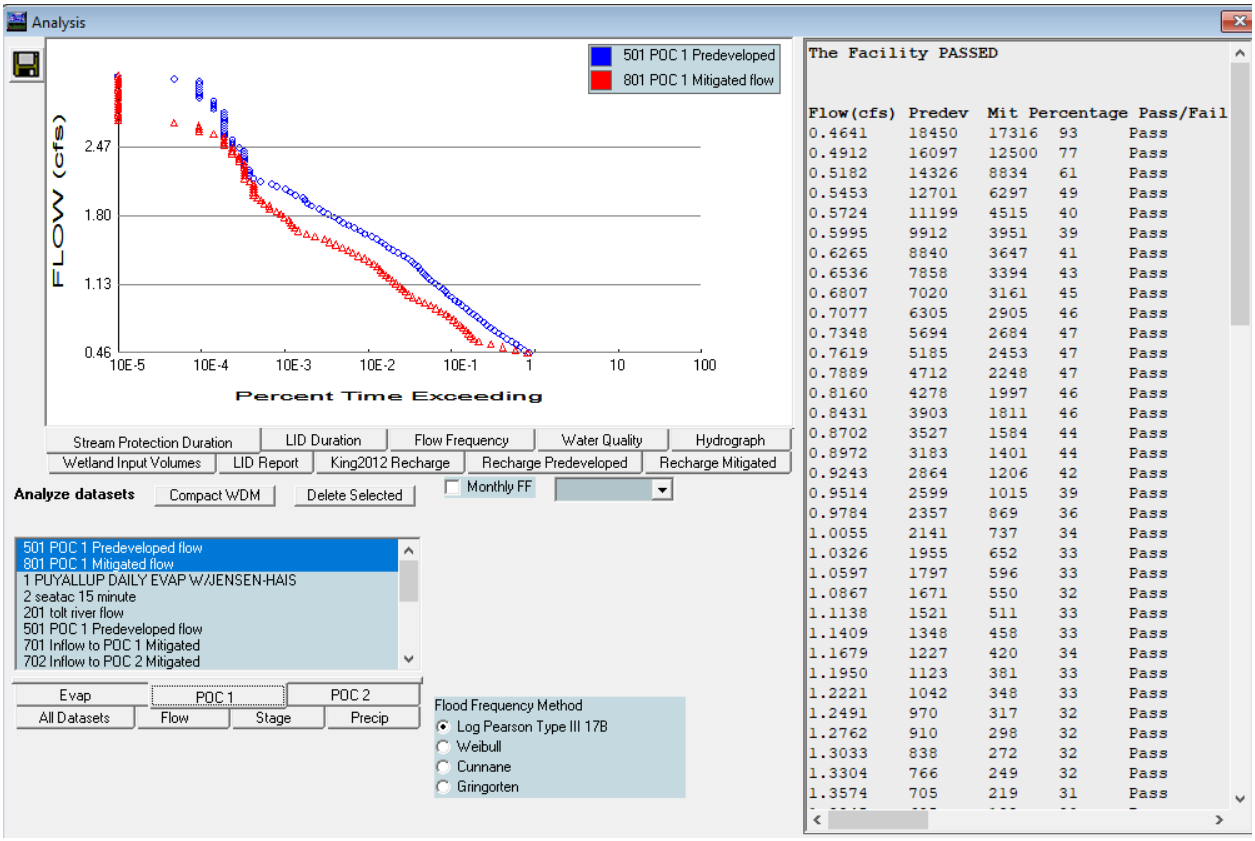
West Basin – Bypass



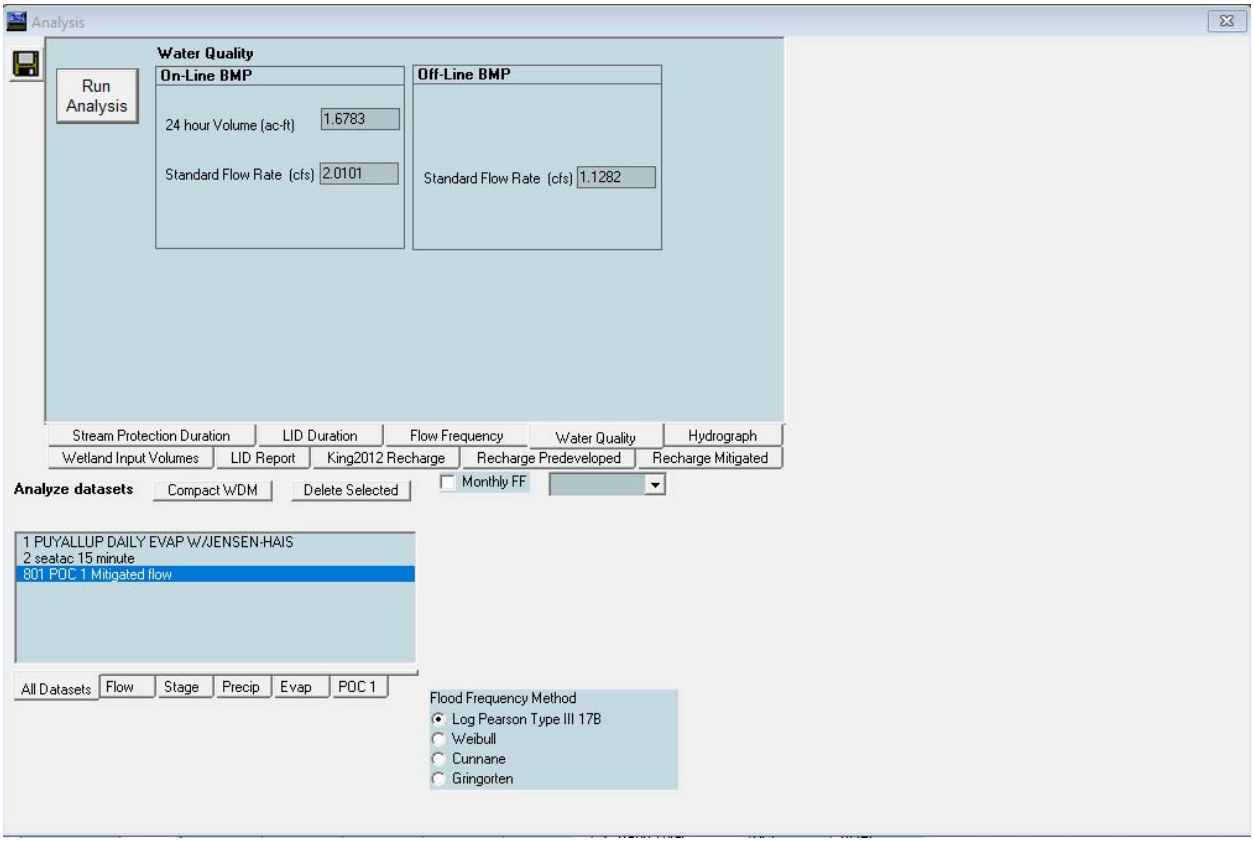
West Detention Pond Design



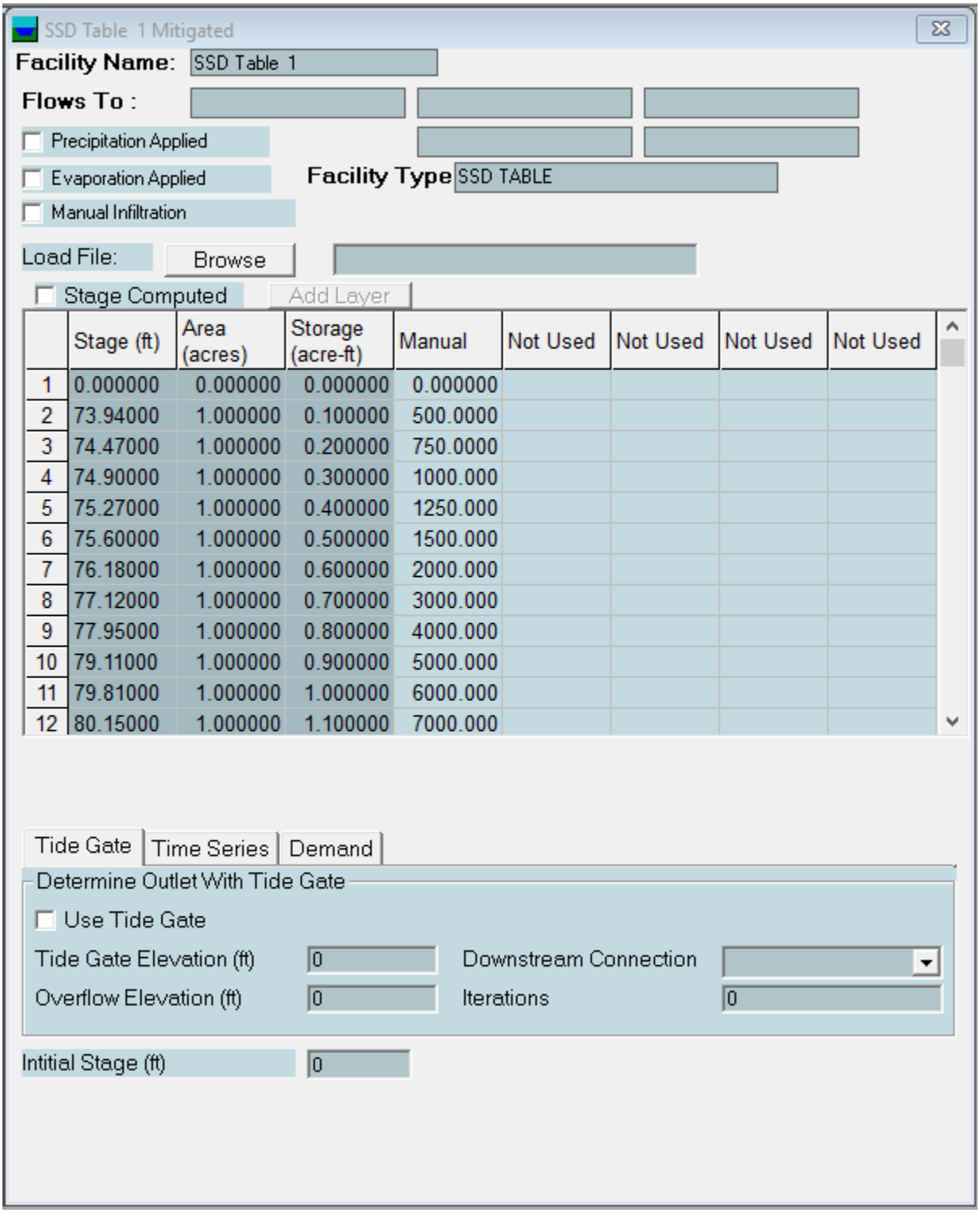
Flow Control Criteria for West Detention Pond



West Detention Pond – Water Quality Volume



Stage-Storage-Discharge Table – Tolt River



SSD Table 1 Mitigated

Facility Name: SSD Table 1

Flows To :

Precipitation Applied

Evaporation Applied

Facility Type SSD TABLE

Manual Infiltration

Load File: Browse

Stage Computed Add Layer

	Stage (ft)	Area (acres)	Storage (acre-ft)	Manual	Not Used	Not Used	Not Used	Not Used
1	0.000000	0.000000	0.000000	0.000000				
2	73.94000	1.000000	0.100000	500.0000				
3	74.47000	1.000000	0.200000	750.0000				
4	74.90000	1.000000	0.300000	1000.000				
5	75.27000	1.000000	0.400000	1250.000				
6	75.60000	1.000000	0.500000	1500.000				
7	76.18000	1.000000	0.600000	2000.000				
8	77.12000	1.000000	0.700000	3000.000				
9	77.95000	1.000000	0.800000	4000.000				
10	79.11000	1.000000	0.900000	5000.000				
11	79.81000	1.000000	1.000000	6000.000				
12	80.15000	1.000000	1.100000	7000.000				

Tide Gate | Time Series | Demand

Determine Outlet With Tide Gate

Use Tide Gate

Tide Gate Elevation (ft) 0

Overflow Elevation (ft) 0

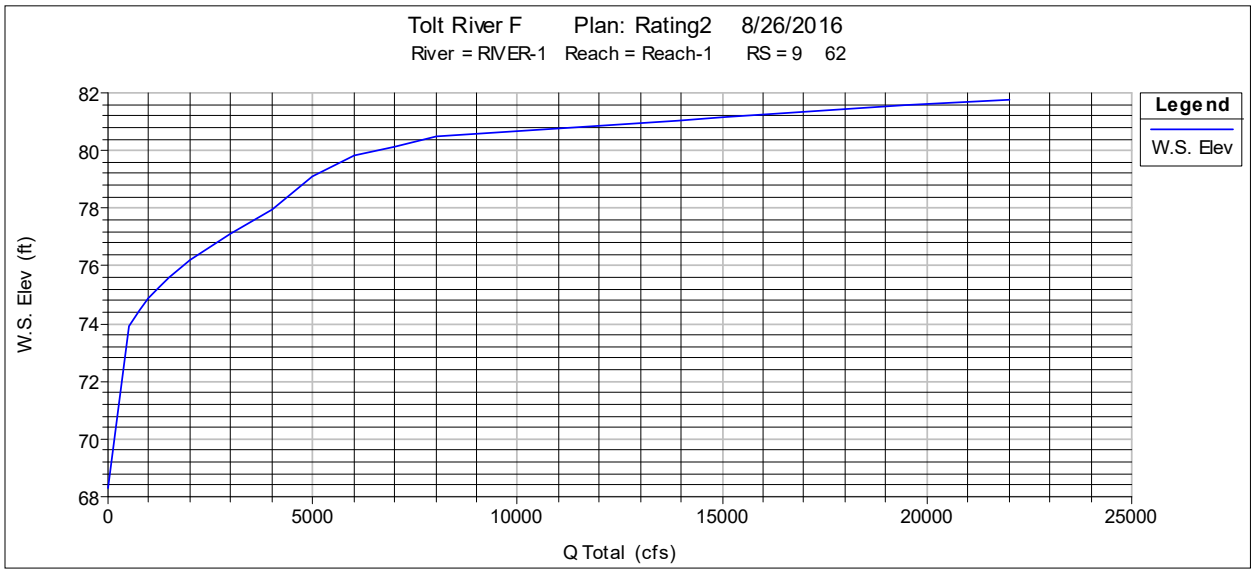
Downstream Connection

Iterations 0

Intitial Stage (ft) 0

Rating Curve for RS 9.0 (Used as backwater condition for west detention pond design)

RS 9.0 is located 440 feet upstream from the SR 203 bridge.

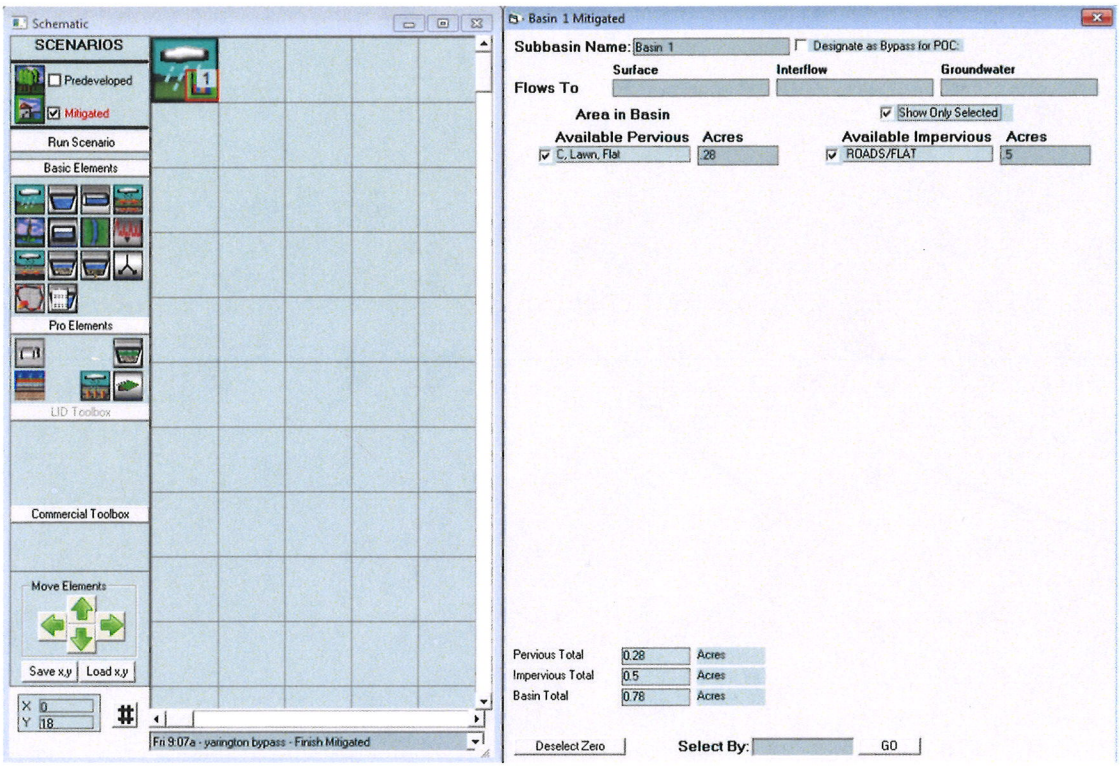


Return Period	Flow Rate	W.S. Elev NAVD88
(Yrs)	(CFS)	(FT)
	-	68.30
	500	73.94
	750	74.47
	1,000	74.90
	1,250	75.27
	1,500	75.60
	2,000	76.18
	3,000	77.12
	4,000	77.95
	5,000	79.11
	6,000	79.81
	7,000	80.15
	8,000	80.48
10	13,900	81.04
	15,000	81.15
50	19,500	81.56
100	22,000	81.77

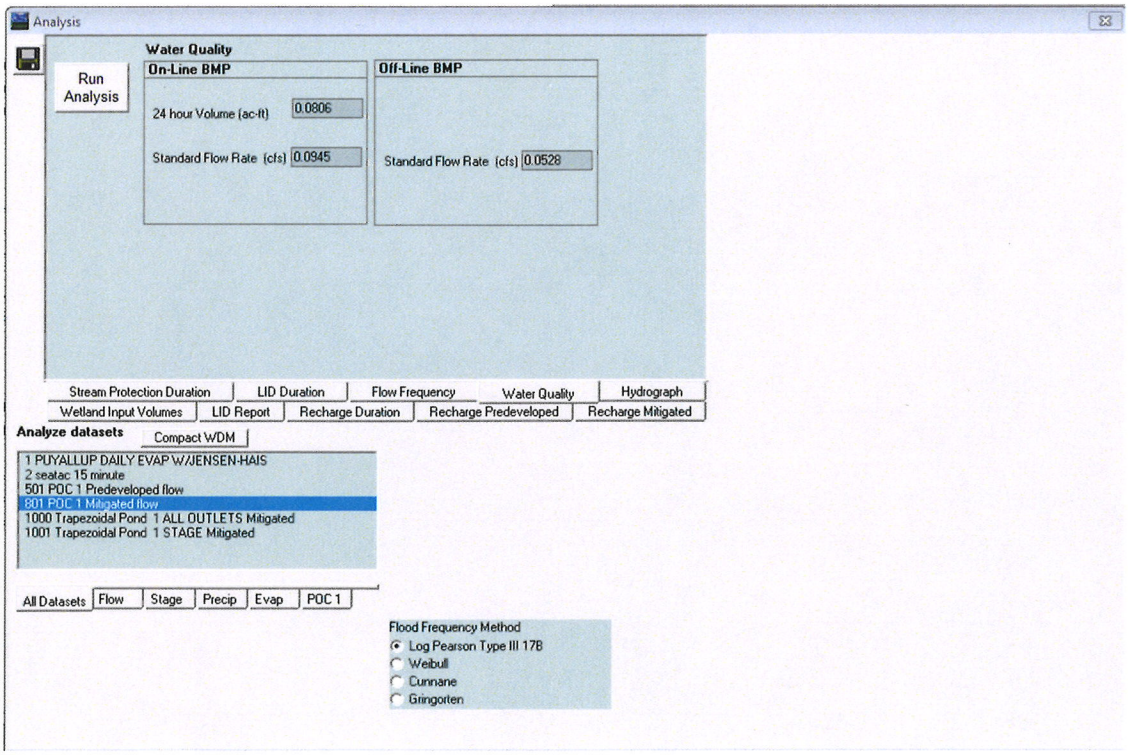
Figure 5.6.1

Western Bypass Water Quality Pond Sizing

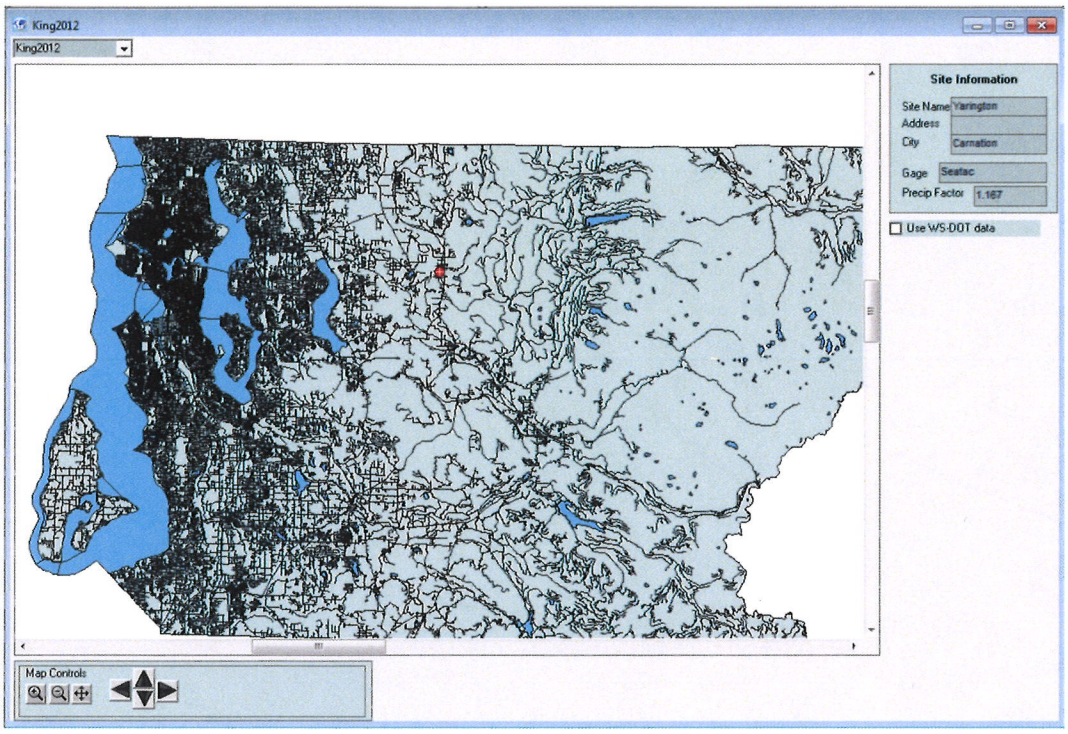
WWHM2012 –Developed - Bypass



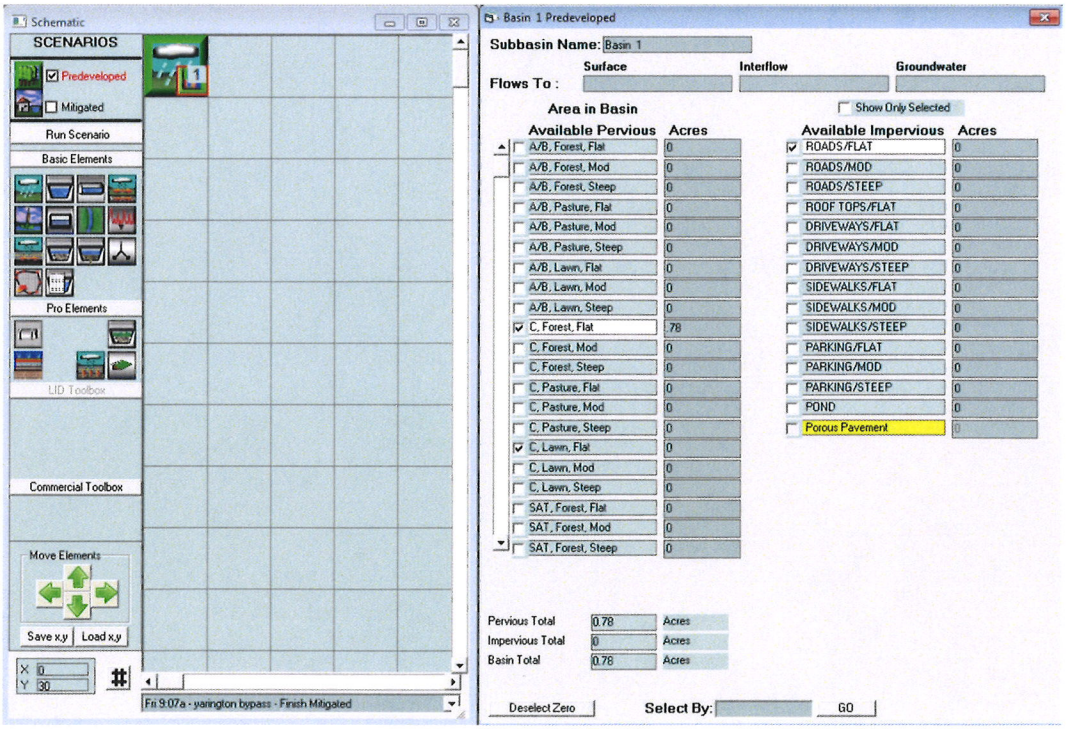
WWHM2012 –Water Quality



WWHM2012 – Precip Factor



WWHM2012 –Predeveloped -Bypass



5.7 Conveyance System Analysis and Design

The Off-Site Analysis Report provided in Section 3.0, has shown that there is no cause for concern in terms of the existing downstream conveyance system and its ability to accommodate the proposed site development. As a result no negative impacts are expected to arise downstream of the existing site as a result of the construction of The Plat of Tolt River Terrace.

The conveyance system analysis and design of the on-site portions of this project will be provided within this section of the report during Final Engineering Review.

Tab 6.0

6.0 CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

The following is a list of the twelve SWPPP elements and how they have been addressed for this project:

Element #1 - Preserve Vegetation / Mark Clearing Limits: Clearing Limits will be delineated on the engineering plans and will be flagged in the field.

Element #2 - Establish Construction Access: A stabilized gravel construction entrance will be shown on the engineering plans.

Element #3 - Control Flow Rates: A temporary sediment ponds will be shown on the engineering plans. Once the permanent detention facilities are constructed the temporary sediment ponds can be removed. The permanent facilities can be used throughout the remainder of construction.

Element #4 - Install Sediment Controls: Silt fence will be shown on the engineering plans for perimeter protection. In addition, temporary ditches to divert runoff to the sediment pond will be shown on the engineering plans.

Element #5 - Stabilize Soils: Cover measures will be addressed in the TESC notes on the engineering plans.

Element #6 - Protect Slopes: There are no significant slopes onsite, existing or proposed that require additional measures beyond the soil stabilization measures to be shown on the engineering plans.

Element #7 - Protect Permanent Drain Inlets: A detail for catch basin inserts will be shown on the final engineering plans along with a note specifying that they be installed once the permanent storm system is completed. A note will also be included that the contractor shall keep public roadways clear of dirt and debris.

Element #8 - Stabilize Channels and Outlets: Notes regarding outfall protection will be shown on the engineering plans. Temporary ditches shall be armored with rip rap for slopes greater than 5 percent.

Element #9 - Control Pollutants: A note will be added to the engineering plans that the contractor shall dispose of all pollutants and waste materials in a safe and timely manner.

Element #10 - Control Dewatering: Notes will be added to the engineering plans stating that water in underground utility trenches or low spots are to be routed to the temporary sediment pond via temporary ditches or perforated rock drains.

Element #11 - Maintain Best Management Practices Once the engineering plans are completed the contractor shall maintain all erosion control measures in accordance with Snohomish County Standards and manufactures recommendations. In addition the contractor shall maintain a stockpile of erosion control materials onsite.

Element #12 - Manage the Project: Once the engineering plans are completed, the clearing, grading, and seasonal work shall be performed in accordance with Snohomish County Code. The contractor shall inspect, maintain, and repair all BMPs as needed to assure continued performance of their intended function. In addition to the engineering plans the contractor will be required to follow and maintain the Construction SWPPP which has been prepared according to Department of Ecology NPDES requirements. The completed SWPPP and TESC Plans will be provided during Final Engineering Review.

Tab 7.0

7.0 SPECIAL REPORTS AND STUDIES

This section contains the following information:

7.1 Geotechnical Engineering Report by The Riley Group, Inc. dated August 17, 2016

7.2 Stormwater Infiltration Evaluation by The Riley Group, Inc. dated January 23, 2017

7.1

Geotechnical Engineering Report prepared by The Riley Group, Inc. dated August 17, 2016

GEOTECHNICAL ENGINEERING REPORT

PREPARED BY:

THE RILEY GROUP, INC.
17522 BOTHELL WAY NORTHEAST
BOTHELL, WASHINGTON 98011

PREPARED FOR:

MAINVUE HOMES
1110 112TH AVENUE NORTHEAST, SUITE 202
BELLEVUE, WASHINGTON 98004

RGI PROJECT NO. 2016-115

CARNATION PROPERTY
KING COUNTY TAX PARCELS 2125079035, 2125079062, AND 2125079063
CARNATION, WASHINGTON

AUGUST 17, 2016

Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone 425.415.0551 ♦ Fax 425.415.0311

www.riley-group.com

RILEYGROUP

August 17, 2016

Barbara Yarington
MainVue Homes
1110 112th Avenue Northeast, Suite 202
Bellevue, Washington 98004

Subject: **Geotechnical Engineering Report**
King County Tax Parcels 2125079035, 2125079062, AND 2125079063
Carnation, Washington
RGI Project No. 2016-115

Dear Ms. Yarington:

As requested, The Riley Group, Inc. (RGI) has performed a Geotechnical Engineering Report (GER) for the MainVue Homes Property (King County Tax Parcels 2125079035, 2125079062, AND 2125079063) located in Carnation, Washington. Our services were completed in accordance with our proposal PRP2016-209 dated June 29, 2016 and authorized by MainVue Homes on July 1, 2016. The information in this GER is based on our understanding of the proposed construction, and the soil and groundwater conditions encountered in the test pits completed by RGI at the site on December 17, 2015.

RGI recommends that you submit the project plans and specifications to RGI for a general review so that we may confirm that the recommendations in this GER are interpreted and implemented properly in the construction documents. RGI also recommends that a representative of our firm be present on site during portions of the project construction to confirm that the soil and groundwater conditions are consistent with those that form the basis for the engineering recommendations in this GER.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

THE RILEY GROUP, INC.

KRISTINA MARIE WELLER
STATE OF WASHINGTON
33182
REGISTERED
PROFESSIONAL ENGINEER

8/17/16

David Baumgarten, LHG
Senior Hydrogeologist

Kristina M. Weller, PE
Senior Project Engineer

Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone 425.415.0551 ♦ Fax 425.415.0311

www.riley-group.com

TABLE OF CONTENTS

LIST OF FIGURES AND APPENDICES

Executive Summary

This Executive Summary should be used in conjunction with the entire Geotechnical Engineering Report (GER) for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the GER must be read in its entirety for a comprehensive understanding of the items contained herein. Section 7.0 should be read for an understanding of limitations.

RGI's geotechnical scope of work included the advancement of 16 test pits to approximate depths of 9 to 16.5 feet below existing site grades.

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified:

Soil Conditions: The soils encountered during field exploration include dense sandy gravels, gravel with silt, sand with silt and gravel, and gravelly sand with silt with occasional layers of dense silty sand. The gravel with sand is underlain by stiff sandy silt in the southwest portion of the Site. Fill soils of varying thickness were encountered in several test pits.

Groundwater: Light groundwater seepage was encountered in some of the test pits from 4.5 to 12 feet below ground surface during our subsurface exploration.

Foundations: Foundations for the proposed single-family building may be supported on conventional spread footings bearing on medium dense native soil or structural fill.

Slab-on-grade: Slab-on-grade floors and slabs for the proposed building can be supported on medium dense native soil or structural fill.

Pavements: The following pavement sections are recommended:

- **For heavy traffic areas**: 3 inches of Hot Mix Asphalt (HMA) over 6 inches of crushed rock base (CRB)
- **For general parking areas**: 2 inches of HMA over 4 inches of CRB

1.0 Introduction

This Geotechnical Engineering Report (GER) presents the results of the geotechnical engineering services provided for the proposed residential development at the site. The purpose of this evaluation is to assess subsurface conditions and provide geotechnical recommendations for the construction of single-family detached homes with associated infrastructure. Our scope of services included field explorations, laboratory testing, engineering analyses, and preparation of this GER.

The recommendations in the following sections of this GER are based upon our current understanding of the proposed site development as outlined below. If actual features vary or changes are made, RGI should review them in order to modify our recommendations as required. In addition, RGI requests to review the site grading plan, final design drawings and specifications when available to verify that our project understanding is correct and that our recommendations have been properly interpreted and incorporated into the project design and construction.

2.0 Project description

The project site is located in Carnation, Washington. The approximate location of the site is shown on Figure 1.

The site is currently occupied by Floor Solutions, which provides concrete floor polishing and repair services. An approximately 13,520-square-foot light industrial building constructed in 1993 is located in the north central portion of the site. Two cranes, associated with the former tenant, Custom Concrete Casting Corporation, were located near the building. Several storage areas are present across the site for concrete debris, metal scraps, wood chips, soils and miscellaneous products.

The site slopes down from the east to the west with approximately 10 to 14 feet of grade change across the site. Several stormwater ponds are located on the southern property boundary. The eastern portion of the Site is vegetated with grass.

RGI understands that the proposed site development will include demolition of the current structures and construction of single-family detached homes with associated access streets, utilities, and stormwater facilities.

At the time of preparing this GER, building plans were not available for our review. Based on our experience with similar construction, RGI anticipates that the proposed building will be supported on perimeter walls with bearing loads of two to four kips per linear foot, and a series of columns with a maximum load up to 50 kips. Slab-on-grade floor loading of 250 pounds per square foot (psf) are expected.

3.0 Field Exploration and Laboratory Testing

3.1 Field Exploration

On December 17, 2015, RGI observed the excavation of 13 test pits (TP-1 to TP-13). RGI also observed the excavation of three additional test pits (IT-1, IT-2, and IT-3) during infiltration testing at the site in July 2016. The approximate exploration locations are shown on Figure 2.

Field logs of each exploration were prepared by the geologist that continuously observed the excavation. These logs included visual classifications of the materials encountered during drilling as well as our interpretation of the subsurface conditions between samples. The test pit logs included in Appendix A represent an interpretation of the field logs and include modifications based on laboratory observation and analysis of the samples.

3.2 Laboratory Testing

During the field exploration, a representative portion of each recovered sample was sealed in containers and transported to our laboratory for further visual and laboratory examination. Selected samples retrieved from the test pit were tested for moisture content and grain size analysis to aid in soil classification and provide input for the recommendations provided in this GER. The results and descriptions of the laboratory tests are enclosed in Appendix A.

4.0 Site Conditions

4.1 Surface

The subject site includes three parcels of land approximately 33.8 acres in size. The site is bound to the north by Tolt Middle School, to the south and east by developed property and the Tolt River, and to the west by State Route 203.

4.2 Geology

Review of the Geologic Map of King County, Washington, by Derek B. Booth, etc. (2002) indicates that the soil in the project vicinity is mapped as Holocene aged alluvium, which is described as moderately sorted deposits of cobble gravel, pebbly sand, and sandy silt along major rivers and stream channels. These descriptions are generally similar to our findings in the field.

4.3 Soils

The soils encountered during field exploration include dense sandy gravels, gravel with sand, sand with silt and gravel, and gravelly sand with silt with layers of dense silty sand. The gravel with sand in underlain by stiff sandy silts on the southwest portion of the site.

Existing fill was encountered on the surface in several test pits, up to 6 feet below grade in test pit TP-5 and the full depth of test pit TP-10. Subsurface conditions encountered in the test pits are also shown on east-west trending cross sections A-A' and B-B' (Figure 3).

More detailed descriptions of the subsurface conditions encountered are presented in the test pit logs included in Appendix A. Sieve analysis was performed on six selected soil samples. Grain size distribution curves are included in Appendix A.

4.4 GROUNDWATER

Light groundwater seepage was encountered from 4.5 feet to 12 feet below ground surface during our subsurface exploration in a few of the test pits. The groundwater is perched over the top of silty layers. Test pits completed in July 2016 (IT-1, IT-2, and IT-3) in the channel migration zone encountered what is in interpreted to be the regional groundwater table at approximately 15 feet below grade.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the explorations were performed. In addition, perched water can develop within seams and layers contained in fill soils or higher permeability soils overlying less permeable soils following periods of heavy or prolonged precipitation. Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the logs. Groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.5 SEISMIC CONSIDERATIONS

Based on the 2012 International Building Code (IBC), RGI recommends the follow seismic parameters for design.

Table 1 2012 IBC

Parameter	Value
Site Soil Class[1]	D[2]
Site Latitude	47.640347° N
Site Longitude	121.913030° W
Short Period Spectral Response Acceleration, S_S (g)	1.170
1-Second Period Spectral Response Acceleration, S_1 (g)	0.444
Adjusted Short Period Spectral Response Acceleration, S_{MS} (g)	1.207
Adjusted 1-Second Period Spectral Response Acceleration, S_{M1} (g)	0.691

1. Note: In general accordance with Chapter 20 of ASCE 7. The Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

2. Note: The 2012 IBC and ASCE 7 require a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope of our services does not include the required 100 foot soil profile determination. Test pits extended to a maximum depth of 16.5 feet, and this seismic site class definition considers that similar soil continues below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations from a seismic event. Liquefaction mainly affects geologically recent deposits of fine-grained sands that are below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction, thus reducing or eliminating the soil's strength.

RGI reviewed the results of the field and laboratory testing and assessed the potential for liquefaction of the site's soil during an earthquake. Since the site is underlain by sand and gravel or stiff silt below the groundwater table, RGI considers that the possibility of liquefaction during an earthquake is low.

4.6 GEOLOGIC HAZARD AREAS

Regulated geologically hazardous areas include erosion, landslide, earthquake, or other geological hazards. Based on the definition in the City of Carnation Municipal Code, the site does not contain geologically hazardous areas.

5.0 Discussion and Recommendations

5.1 GEOTECHNICAL CONSIDERATIONS

Based on our study, the site is suitable for the proposed construction from a geotechnical standpoint. Foundations for the proposed building can be supported on conventional spread footings bearing on medium dense native soil or structural fill. Slab-on-grade and pavements can be similarly supported.

Detailed recommendations regarding the above issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 EARTHWORK

Based on the planned residential development, the earthwork is expected to consist of grading the site to obtain individual building lots and street grades, installing underground utilities, and preparing street and sidewalk subgrades. The earth work for the subsequent construction of homes is expected to be limited to excavating and backfilling the foundations and tying into utilities on the lots.

5.2.1 EROSION AND SEDIMENT CONTROL

Potential sources or causes of erosion and sedimentation depend on construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The impacts on erosion-prone areas can be reduced by implementing an erosion and sedimentation control plan. The plan should be designed in accordance with applicable city and/or county standards.

RGI recommends the following erosion control Best Management Practices (BMPs):

- Scheduling site preparation and grading for the drier summer and early fall months and undertaking activities that expose soil during periods of little or no rainfall
- Retaining existing vegetation whenever feasible
- Establishing a quarry spall construction entrance
- Installing siltation control fencing or anchored straw or coir wattles on the downhill side of work areas
- Covering soil stockpiles with anchored plastic sheeting
- Revegetating or mulching exposed soils with a minimum 3-inch thickness of straw if surfaces will be left undisturbed for more than one day during wet weather or one week in dry weather
- Directing runoff away from exposed soils and slopes
- Minimizing the length and steepness of slopes with exposed soils and cover excavation surfaces with anchored plastic sheeting (Graded and disturbed slopes should be tracked in place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion and channeling. Some sloughing and raveling of slopes with exposed or disturbed soil should be expected.)
- Decreasing runoff velocities with check dams, straw bales or coir wattles
- Confining sediment to the project site
- Inspecting and maintaining erosion and sediment control measures frequently (The contractor should be aware that inspection and maintenance of erosion control BMPs is critical toward their satisfactory performance. Repair and/or replacement of dysfunctional erosion control elements should be anticipated.)

Permanent erosion protection should be provided by reestablishing vegetation using hydroseeding and/or landscape planting. Until the permanent erosion protection is established, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

5.2.2 STRIPPING

Stripping efforts should include removal of pavements, vegetation, organic materials, and deleterious debris from areas slated for residences, pavement, and utility construction. Fill soils were encountered in some of the test pits completed at the site. Several feet of fill soils were encountered in the test pits completed in the channel migration zone and up to 12 feet of fill soils were encountered in exploration pits TP-5 and TP-10.

Our understanding of the history of the site indicates the material excavated to create the three ponds on the southern portion of the site was placed as fill across the site. Some of the fill soils observed in the test pits included woody debris, crushed concrete and bricks. Deeper areas of stripping and or removal of unsuitable fill soils may be required in some areas of the site were these soils are unsuitable for reuse or support of the proposed improvements.

5.2.3 EXCAVATIONS

All temporary cut slopes associated with the site and utility excavations should be adequately inclined to prevent sloughing and collapse. The site soils consist of medium dense sand and gravel, silt, silty sand and fill.

Accordingly, for excavations more than 4 feet but less than 20 feet in depth, the temporary side slopes should be laid back with a minimum slope inclination of 1.5H:1V (Horizontal:Vertical). If there is insufficient room to complete the excavations in this manner, or excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations should be considered. For open cuts at the site, RGI recommends:

- No traffic, construction equipment, stockpiles or building supplies are allowed at the top of cut slopes within a distance of at least five feet from the top of the cut
- Exposed soil along the slope is protected from surface erosion using waterproof tarps and/or plastic sheeting
- Construction activities are scheduled so that the length of time the temporary cut is left open is minimized
- Surface water is diverted away from the excavation
- The general condition of slopes should be observed periodically by a geotechnical engineer to confirm adequate stability and erosion control measures

In all cases, however, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable OSHA or WISHA guidelines.

5.2.4 SITE PREPARATION

RGI anticipates that some areas of loose or soft soil and fill soils will be exposed upon completion of stripping and grubbing. Proofrolling and subgrade verification should be considered an essential step in site preparation. After stripping, grubbing, and prior to placement of structural fill, RGI recommends proofrolling building and pavement subgrades and areas to receive structural fill. These areas should moisture conditioned and compacted to a firm and unyielding condition in order to achieve a minimum compaction level of 95 percent of the modified proctor maximum dry density as determined by the American Society of Testing and Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

Proofrolling and adequate subgrade compaction can only be achieved when the soils are within approximately ± 2 percent moisture content of the optimum moisture content. Soils which appear firm after stripping and grubbing may be proofrolled with a heavy compactor, loaded double-axle dump truck, or other heavy equipment under the observation of an RGI representative. This observer will assess the subgrade conditions prior to filling. The need for or advisability of proofrolling due to soil moisture conditions should be determined at the time of construction. In wet areas it may be necessary to hand probe the exposed subgrades in lieu of proofrolling with mechanical equipment.

If fill is placed in areas of the site where existing slopes are steeper than 5:1 (Horizontal:Vertical), the area should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be wide enough to accommodate compaction and earth moving equipment, and to allow placement of horizontal lifts of fill.

Subgrade soils that become disturbed due to elevated moisture conditions should be overexcavated to reveal firm, non-yielding, non-organic soils and backfilled with compacted structural fill. In order to maximize utilization of site soils as structural fill, RGI recommends that the earthwork portion of this project be completed during extended periods of warm and dry weather if possible. If earthwork is completed during the wet season (typically November through May) it will be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork will require additional mitigative measures beyond that which would be expected during the drier summer and fall months.

5.2.5 STRUCTURAL FILL

Once stripping, clearing and other preparing operations are complete, cuts and fills can be made to establish desired lot and street grades. Prior to placing fill, RGI recommends proof-rolling as described above.

RGI recommends fill below the foundation and floor slab, behind retaining walls, and below pavement and hardscape surfaces be placed in accordance with the following

recommendations for structural fill. The structural fill should be placed after completion of site preparation procedures as described above.

The suitability of excavated site soils and import soils for compacted structural fill use will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion passing the U.S. No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve. Soils containing more than about 5 percent fines cannot be consistently compacted to a dense, non-yielding condition when the moisture content is more than 2 percent above or below optimum. Optimum moisture content is that moisture that results in the greatest compacted dry density with a specified compactive effort.

Non-organic site soils are only considered suitable for structural fill provided that their moisture content is within about two percent of the optimum moisture level as determined by ASTM D1557. Excavated site soils may not be suitable for re-use as structural fill depending on the moisture content and weather conditions at the time of construction. If soils are stockpiled for future reuse and wet weather is anticipated, the stockpile should be protected with plastic sheeting that is securely anchored. Even during dry weather, moisture conditioning (such as, windrowing and drying) of site soils to be reused as structural fill may be required. Even during the summer, delays in grading can occur due to excessively high moisture conditions of the soils or due to precipitation. If wet weather occurs, the upper wetted portion of the site soils may need to be scarified and allowed to dry prior to further earthwork, or may need to be wasted from the site.

If on-site soils are or become unusable, it may become necessary to import clean, granular soils to complete site work that meet the grading requirements listed in Table 2 to be used as structural fill.

Table 2 Structural Fill Gradation

U.S. Sieve Size	Percent Passing
4 inches	100
No. 4 sieve	75 percent
No. 200 sieve	5 percent *

*Based on minus 3/4 inch fraction.

Prior to use, an RGI representative should observe and test all materials imported to the site for use as structural fill. Structural fill materials should be placed in uniform loose layers not exceeding 10 inches and compacted as specified in Table 3. The soil's maximum density and optimum moisture should be determined by ASTM D1557.

Table 3 Structural Fill Compaction ASTM D1557

Location	Material Type	Minimum Compaction Percentage	Moisture Content Range	
Foundations	On-site granular or approved imported fill soils:	95	+2	-2
Retaining Wall Backfill	On-site granular or approved imported fill soils:	92	+2	-2
Slab-on-grade	On-site granular or approved imported fill soils:	95	+2	-2
General Fill (non-structural areas)	On-site soils or approved imported fill soils:	90	+3	-2
Pavement – Subgrade and Base Course	On-site granular or approved imported fill soils:	95	+2	-2

Placement and compaction of structural fill should be observed by RGI. A representative number of in-place density tests should be performed as the fill is being placed to confirm that the recommended level of compaction is achieved.

5.2.6 CUT AND FILL SLOPES

All permanent cut and fill slopes (except interior slopes of detention pond) should be graded with a finished inclination no greater than 2H:1V. The interior slopes of the detention pond must be graded with a slope gradient no steeper than 3H:1V. Upon completion of construction, the slope face should be trackwalked, compacted and vegetated, or provided with other physical means to guard against erosion. All fill placed for slope construction should meet the structural fill requirements as described in Section 5.2.5.

Final grades at the top of the slopes must promote surface drainage away from the slope crest. Water must not be allowed to flow in an uncontrolled fashion over the slope face. If it is necessary to direct surface runoff towards the slope, it should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe of the slope.

5.2.7 WET WEATHER CONSTRUCTION CONSIDERATIONS

RGI recommends that preparation for site grading and construction include procedures intended to drain ponded water, control surface water runoff, and to collect shallow subsurface seepage zones in excavations where encountered. It will not be possible to successfully compact the subgrade or utilize on-site soils as structural fill if accumulated water is not drained prior to grading or if drainage is not controlled during construction. Attempting to grade the site without adequate drainage control measures will reduce the

amount of on-site soil effectively available for use, increase the amount of select import fill materials required, and ultimately increase the cost of the earthwork phases of the project. Free water should not be allowed to pond on the subgrade soils. RGI anticipates that the use of berms and shallow drainage ditches, with sumps and pumps in utility trenches, will be required for surface water control during wet weather and/or wet site conditions.

5.3 FOUNDATIONS

Following site preparation and grading, the proposed building foundation can be supported on conventional spread footings bearing on medium dense native soil or structural fill. Loose, organic, or other unsuitable soils may be encountered in the proposed building footprint. If unsuitable soils are encountered, they should be overexcavated and backfilled with structural fill.

Perimeter foundations exposed to weather should be at a minimum depth of 18 inches below final exterior grades. Interior foundations can be constructed at any convenient depth below the floor slab. Finished grade is defined as the lowest adjacent grade within 5 feet of the foundation for perimeter (or exterior) footings and finished floor level for interior footings.

Table 4 Foundation Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf[1]
Friction Coefficient	0.30
Passive pressure (equivalent fluid pressure)	250 pcf[2]
Minimum foundation dimensions	Columns: 24 inches Walls: 16 inches

1. psf = pounds per square foot
2. pcf = pounds per cubic foot

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. For short-term loads, such as wind and seismic, a 1/3 increase in this allowable capacity may be used. At perimeter locations, RGI recommends not including the upper 12 inches of soil in the computation of passive pressures because they can be affected by weather or disturbed by future grading activity. The passive pressure value assumes the foundation will be constructed neat against competent soil or backfilled with structural fill as described in Section 5.2.5. The recommended base friction and passive resistance value includes a safety factor of about 1.5.

With spread footing foundations designed in accordance with the recommendations in this section, maximum total and differential post-construction settlements of 1 inch and 1/2 inch, respectively, should be expected.

5.4 RETAINING WALLS

If retaining walls are needed in the building area, RGI recommends cast-in-place concrete walls be used. The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. RGI recommends placing and compacting wall backfill as structural fill. Wall drainage will be needed behind the wall face. A typical retaining wall drainage detail is shown in Figure 4.

With wall backfill placed and compacted as recommended, and drainage properly installed, RGI recommends using the values in the following table for design.

Table 5 Retaining Wall Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf
Active Earth Pressure (unrestrained walls)	35 pcf
At-rest Earth Pressure (restrained walls)	50 pcf

For seismic design, an additional uniform load of 7 times the wall height (H) for unrestrained walls and 14H in psf for restrained walls should be applied to the wall surface.

Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 5.3.

5.5 SLAB-ON-GRADE CONSTRUCTION

Once site preparation has been completed as described in Section 5.2, suitable support for slab-on-grade construction should be provided. RGI recommends that the concrete slab be placed on top of medium dense native soil or structural fill. Immediately below the floor slab, RGI recommends placing a four-inch thick capillary break layer of clean, free-draining sand or gravel that has less than five percent passing the U.S. No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

Where moisture by vapor transmission is undesirable, an 8- to 10-millimeter thick plastic membrane should be placed on a 4-inch thick layer of clean gravel.

For the anticipated floor slab loading, we estimate post-construction floor settlements of 1/4- to 1/2-inch. For thickness design of the slab subjected to point loading from storage

racks and fork lift vehicle traffic, RGI recommends using a subgrade modulus (K_S) of 150 pounds per square inch per inch of deflection.

5.6 DRAINAGE

5.6.1 SURFACE

Final exterior grades should promote free and positive drainage away from the building area. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. For non-pavement locations, RGI recommends providing a minimum drainage gradient of 3 percent for a minimum distance of 10 feet from the building perimeter. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structure.

5.6.2 SUBSURFACE

RGI recommends installing perimeter foundation drains. A typical footing drain detail is shown on Figure 5. The foundation drains and roof downspouts should be tightlined separately to an approved discharge facility. Subsurface drains must be laid with a gradient sufficient to promote positive flow to a controlled point of approved discharge.

5.7 UTILITIES

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) specifications. For site utilities located within the right-of-ways, bedding and backfill should be completed in accordance with City of Carnation specifications. At a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 5.2.5. Where utilities occur below unimproved areas, the degree of compaction can be reduced to a minimum of 90 percent of the soil's maximum density as determined by the referenced ASTM D1557. The soils excavated on site may be suitable for use as backfill material. Imported structural fill meeting the gradation provided in Table 2 may be necessary for trench backfill.

5.8 PAVEMENTS

Pavement subgrades should be prepared as described in Section 5.2 and as discussed below. Regardless of the relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. The subgrade should be proof-rolled with heavy construction equipment to verify this condition.

With the pavement subgrade prepared as described above, RGI recommends the following pavement sections for parking and drive areas paved with flexible asphalt concrete surfacing.

- **For heavy traffic areas:** 3 inches of Hot Mix Asphalt (HMA) over 6 inches of crushed rock base (CRB)
- **For general parking areas:** 2 inches of HMA over 4 inches of CRB

The paving materials used should conform to the WSDOT specifications for HMA, concrete paving and CRB surfacing (9-03.9(3) Crushed Surfacing).

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability.

For optimum pavement performance, surface drainage gradients of no less than 2 percent are recommended. Also, some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

6.0 Additional Services

RGI is available to provide further geotechnical consultation throughout the design phase of the project. RGI should review the final design and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design and construction.

RGI is also available to provide geotechnical engineering and construction monitoring services during construction. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this scope of work. If these services are desired, please let us know and we will prepare a cost proposal.

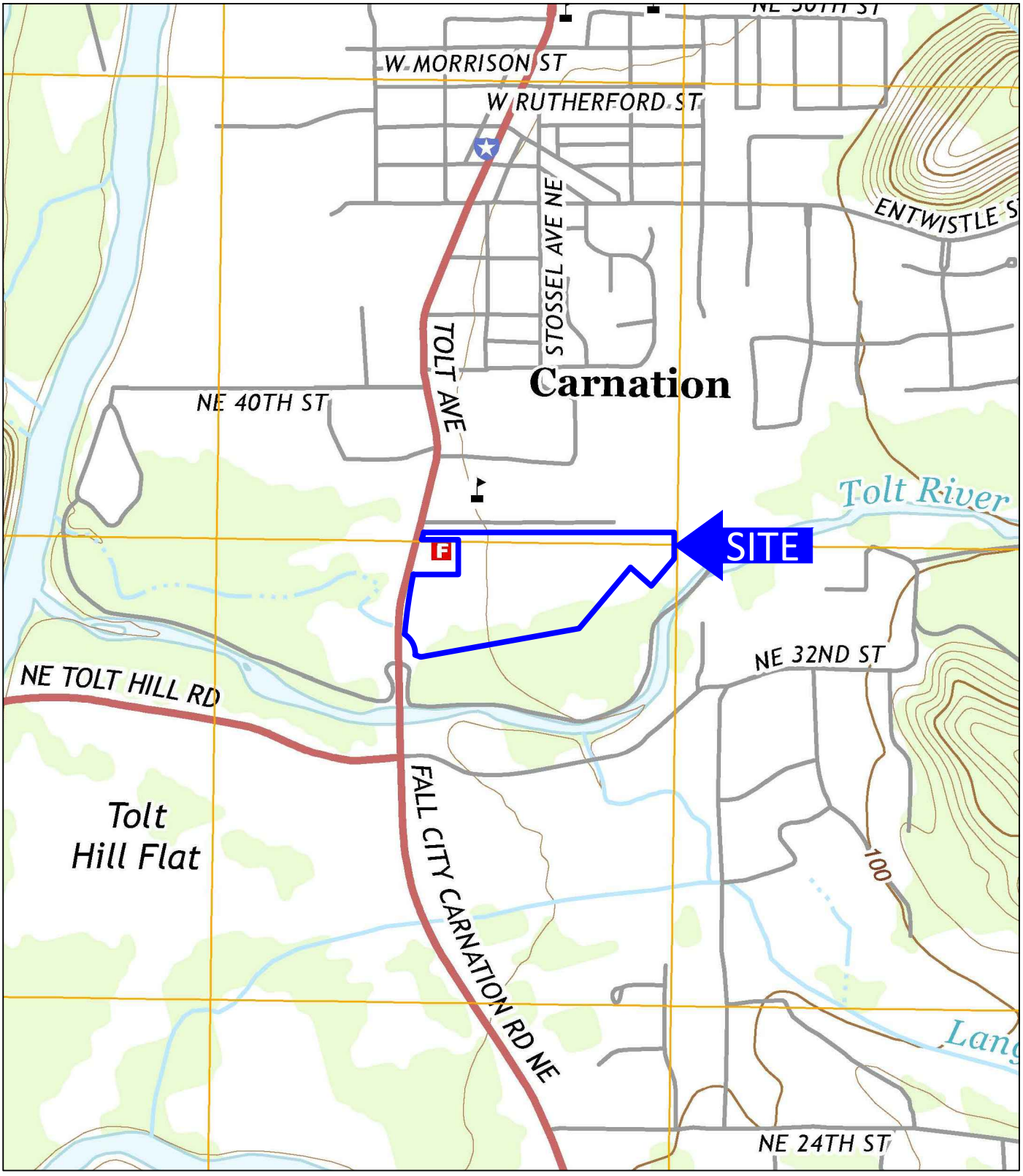
7.0 Limitations

This GER is the property of RGI, MainVue Homes, and its designated agents. Within the limits of the scope and budget, this GER was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this GER was issued. This GER is intended for specific application to the MainVue Homes Carnation property project in Carnation, Washington, and for the exclusive use of MainVue Homes and its authorized representatives. No other warranty, expressed or implied, is made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

The analyses and recommendations presented in this GER are based upon data obtained from the explorations performed on site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear

evident, RGI should be requested to reevaluate the recommendations in this GER prior to proceeding with construction.

It is the client's responsibility to see that all parties to the project, including the designers, contractors, subcontractors, are made aware of this GER in its entirety. The use of information contained in this GER for bidding purposes should be done at the contractor's option and risk.



USGS, 2014, Carnation, Washington
7.5-Minute Quadrangle

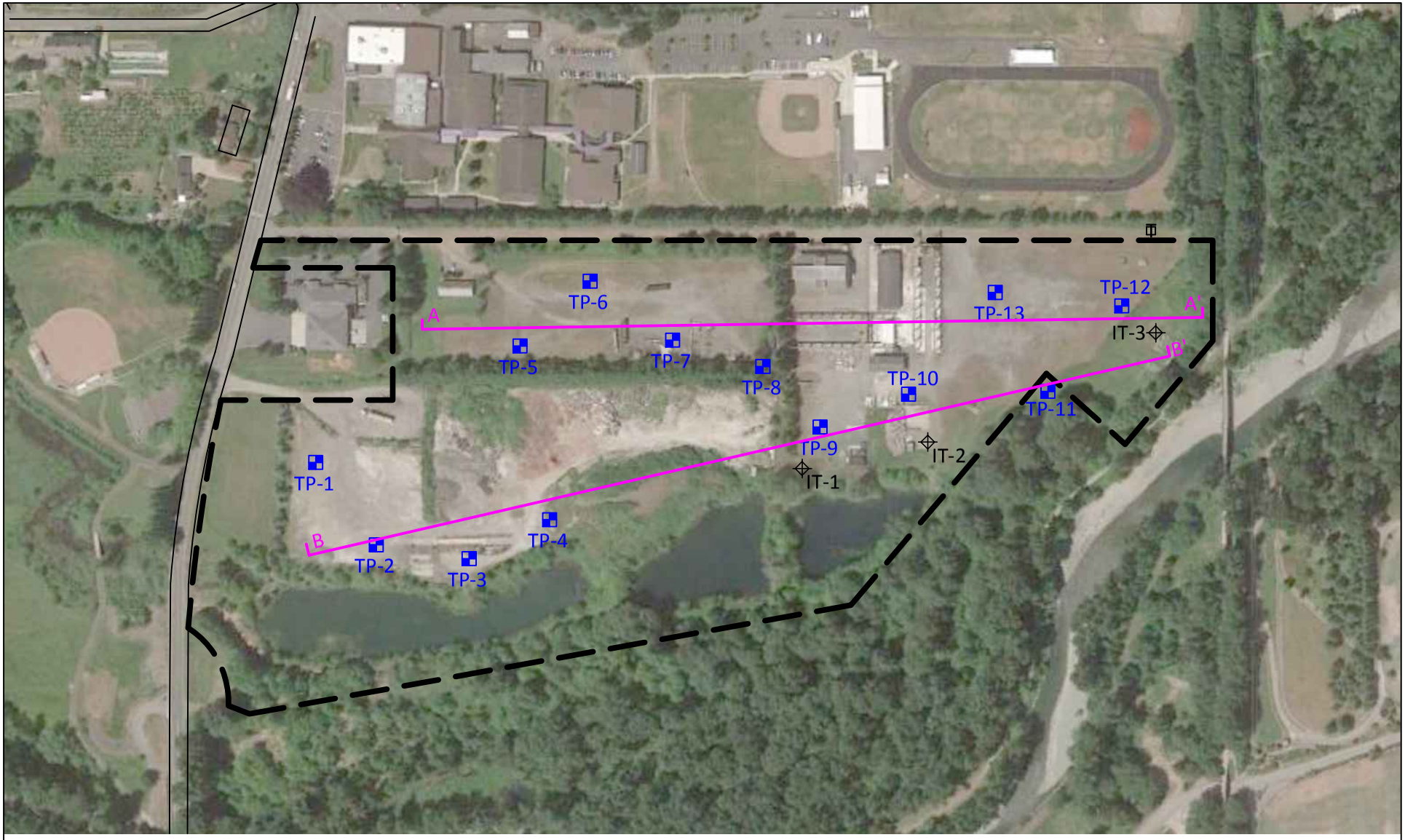
Approximate Scale: 1"=1000'

0 500 1000 2000

N

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

MainVue Homes Carnation Property		Figure 1
RGI Project Number 2016-115	Site Vicinity Map	Date Drawn: 08/2016
Address: 3440 Tolt Avenue, Carnation, Washington 98014		



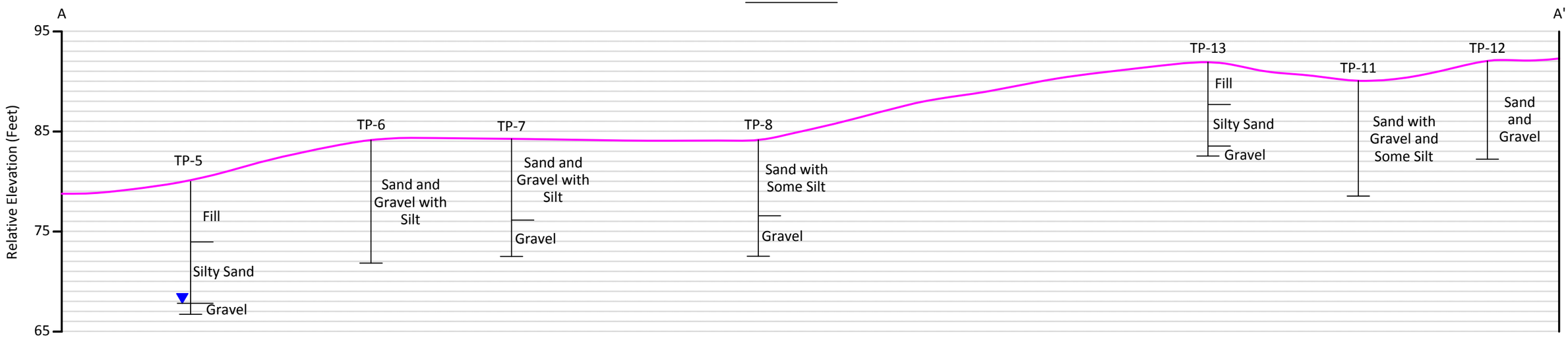
= Infiltration test location, July 2016
= Test pit location, 2015
= Site boundary

Approximate Scale: 1"=40'
0 20 40 80
N

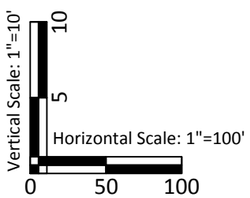
RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

MainVue Homes Carnation Property		Figure 2
RGI Project Number 2016-115	Geotechnical Exploration Plan	Date Drawn: 08/2016
Address: 3440 Tolt Avenue, Carnation, Washington 98014		

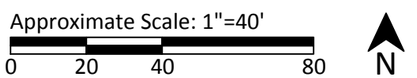
Looking North



Looking North

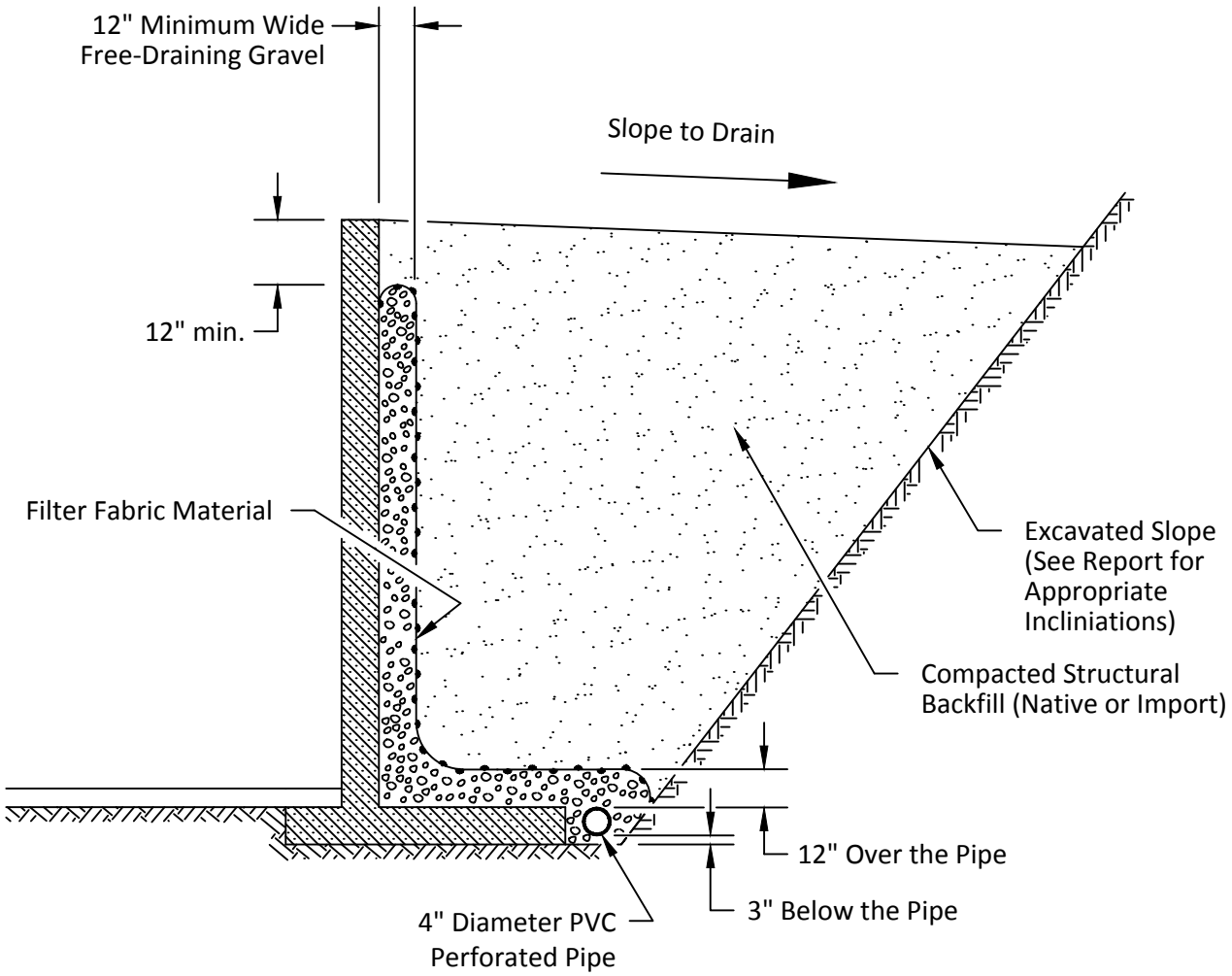


▼ = Groundwater encountered



RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

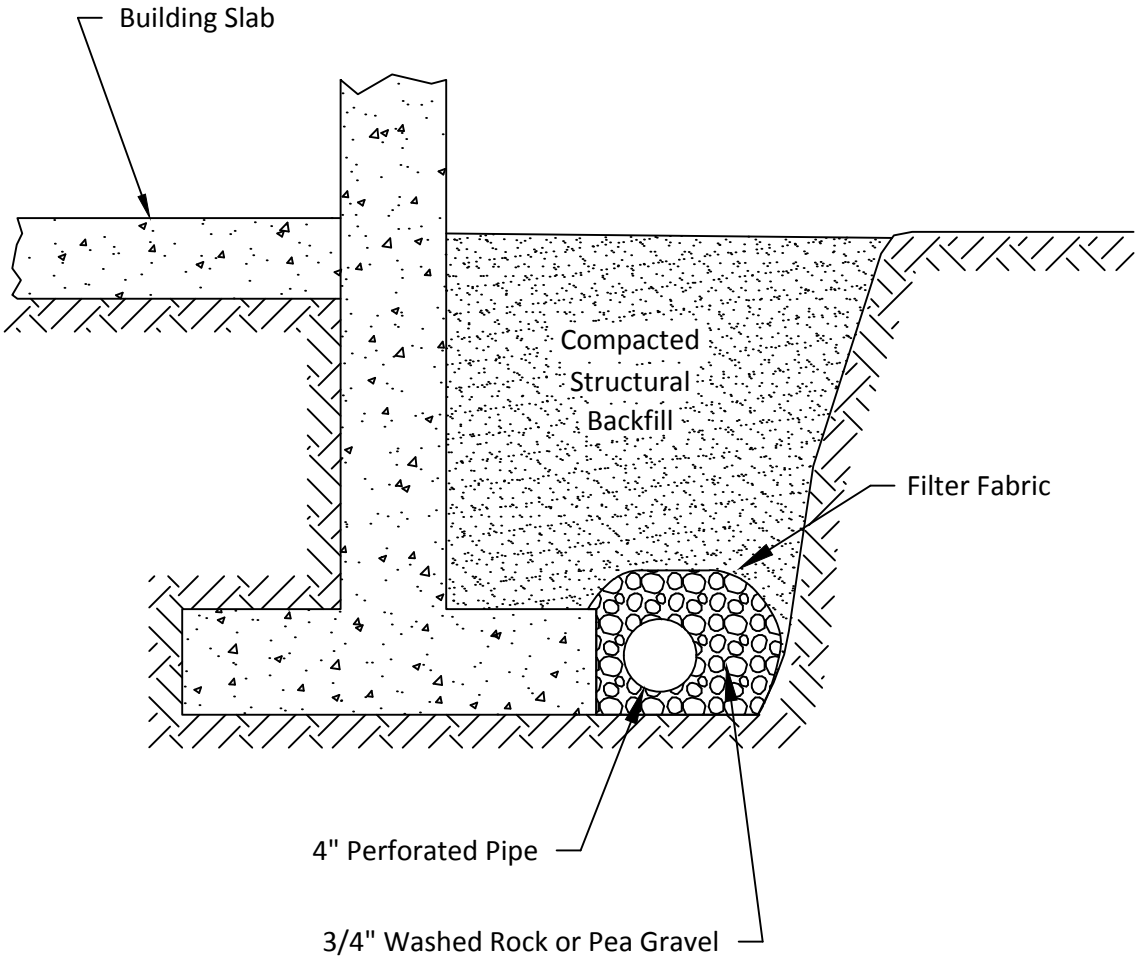
MainVue Homes Carnation Property		Figure 3
RGI Project Number 2016-115	Cross Sections A - A' and B - B'	Date Drawn: 08/2016
Address: 3440 Tolt Avenue, Carnation, Washington 98014		



Not to Scale

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

MainVue Homes Carnation Property		Figure 4
RGI Project Number 2016-115	Retaining Wall Drainage Detail	Date Drawn: 08/2016
Address: 3440 Tolt Avenue, Carnation, Washington 98014		



Not to Scale

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

MainVue Homes Carnation Property		Figure 5
RGI Project Number 2016-115	Typical Footing Drain Detail	Date Drawn: 08/2016
Address: 3440 Tolt Avenue, Carnation, Washington 98014		

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

In December 2015 and July 2016, RGI performed field explorations using a track-mounted excavator. We explored subsurface soil conditions at the site by observing the excavation of 16 test pits (TP-1 through TP-13 and IT-1, IT-2, and IT-3) to a maximum depth of 16.5 feet below existing grade. The test pit locations are shown on Figure 2. The test pit locations were approximately determined by measurements from existing property lines and Site features.

A geologist from our office conducted the field exploration and classified the soil conditions encountered, maintained a log of each test exploration, obtained representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS).

Representative soil samples obtained from the explorations were placed in closed containers and taken to our laboratory for further examination and testing. As a part of the laboratory testing program, the soil samples were classified in our in house laboratory based on visual observation, texture, plasticity, and the limited laboratory testing described below.

Moisture Content Determinations

Moisture content determinations were performed in accordance with ASTM D2216-10 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216) on representative samples obtained from the exploration in order to aid in identification and correlation of soil types. The moisture content of typical sample was measured and is reported on the Test Pit logs.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses was determined using D6913-04(2009) Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM D6913) on nine soil samples.

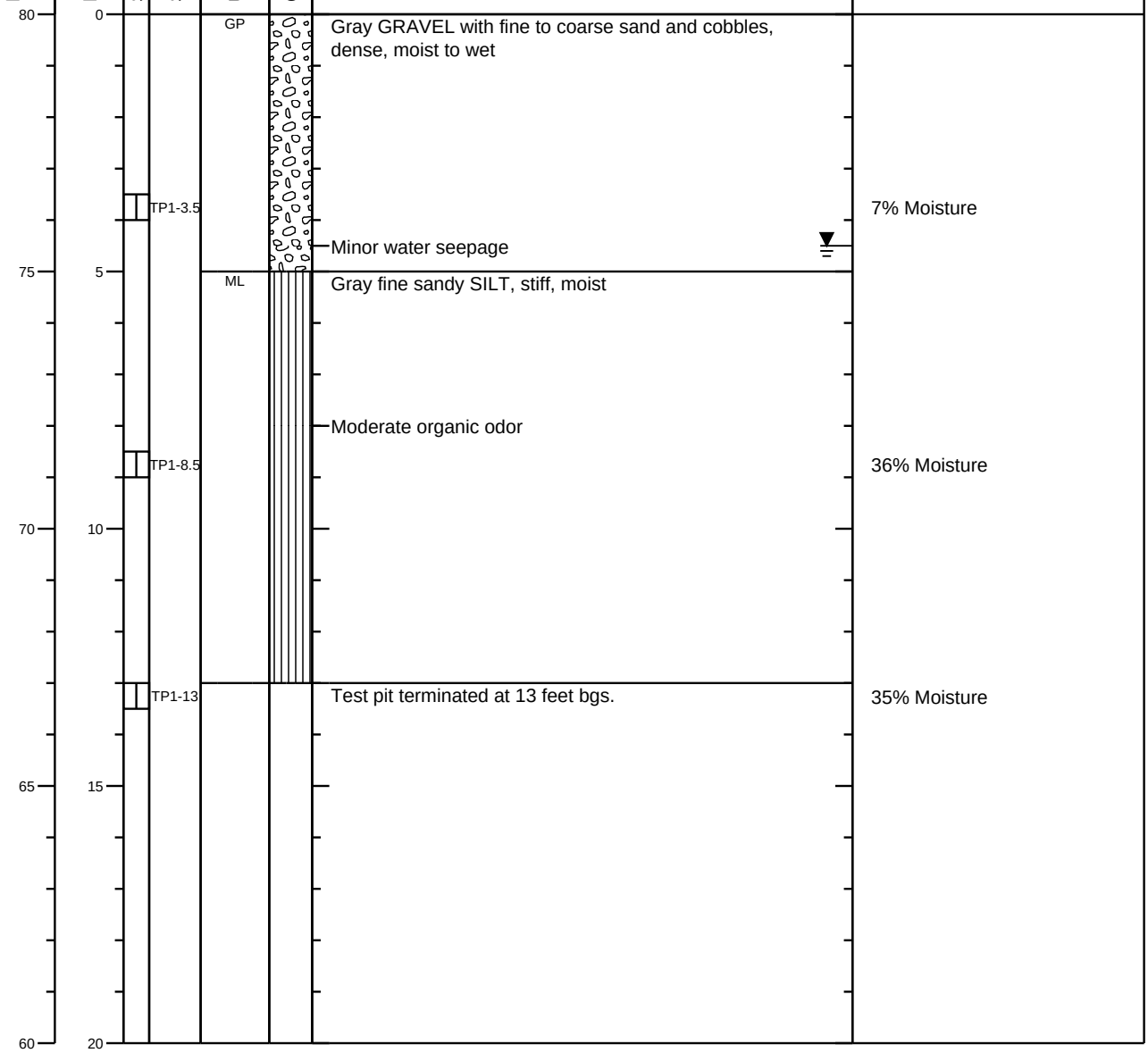
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-1

Sheet 1 of 1

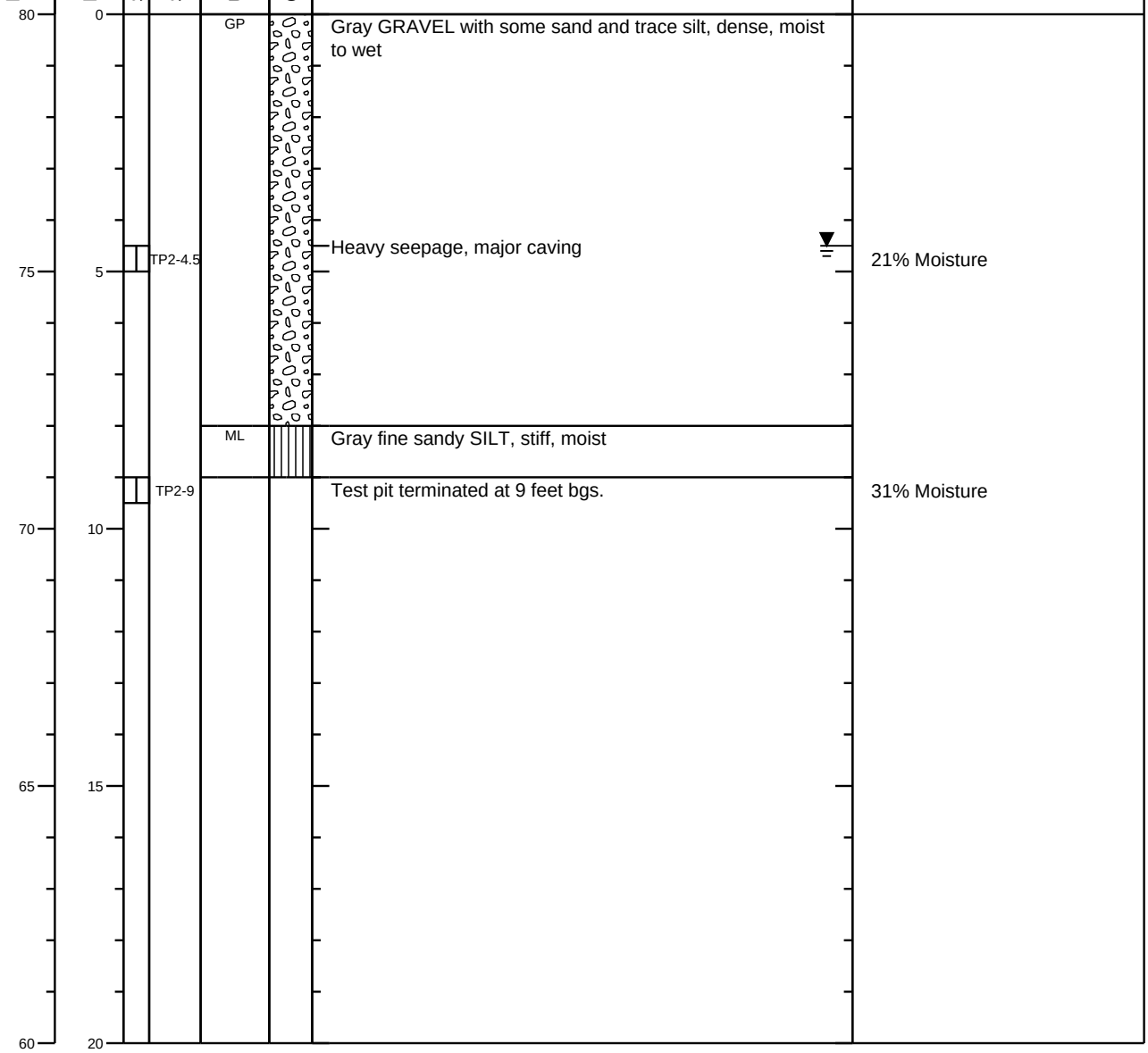
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **13'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **80'**
Groundwater Level: **4.5'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-2 **Sheet 1 of 1**

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **9'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **80'**
Groundwater Level: **4.5'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



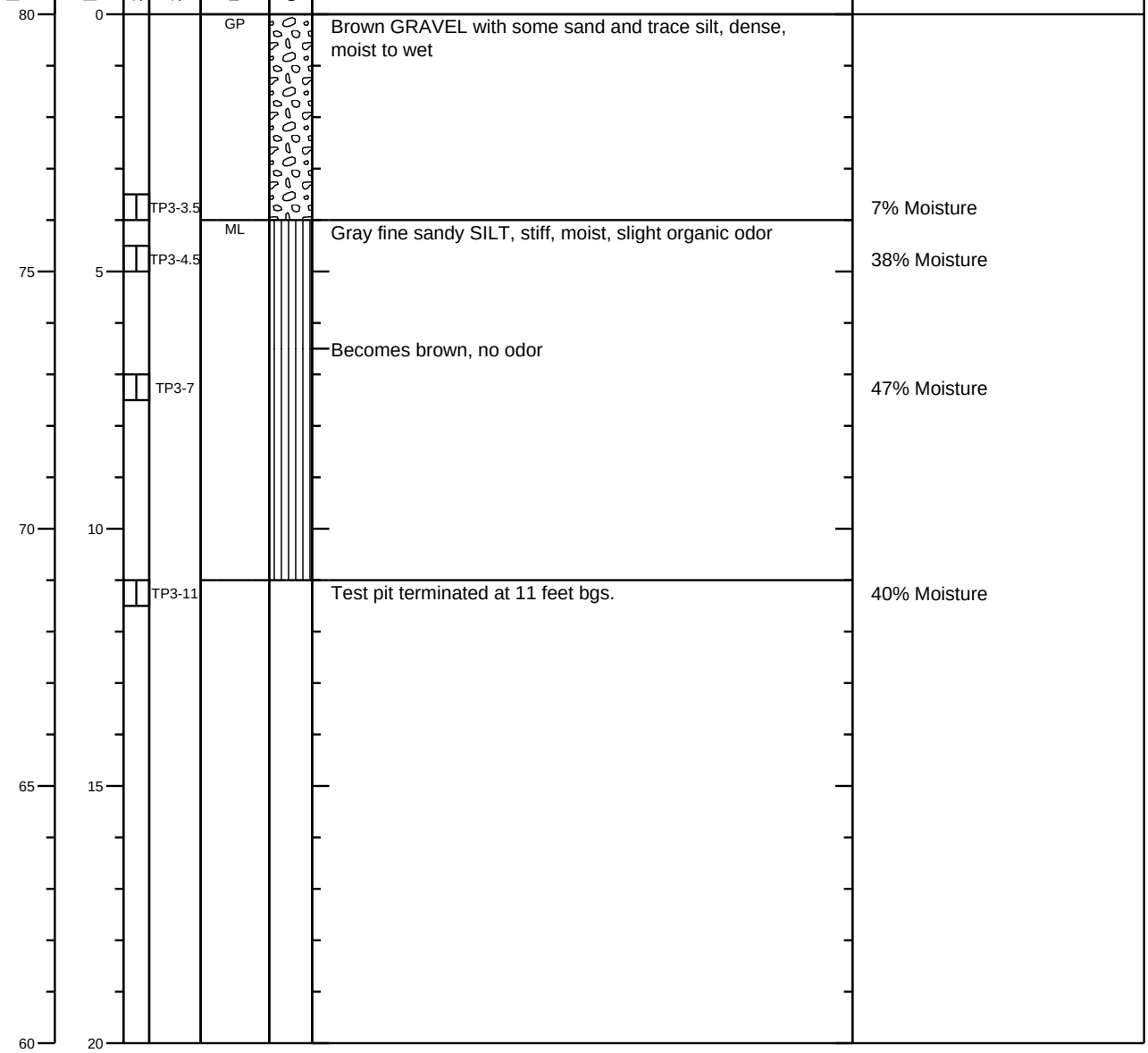
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-3

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **80'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

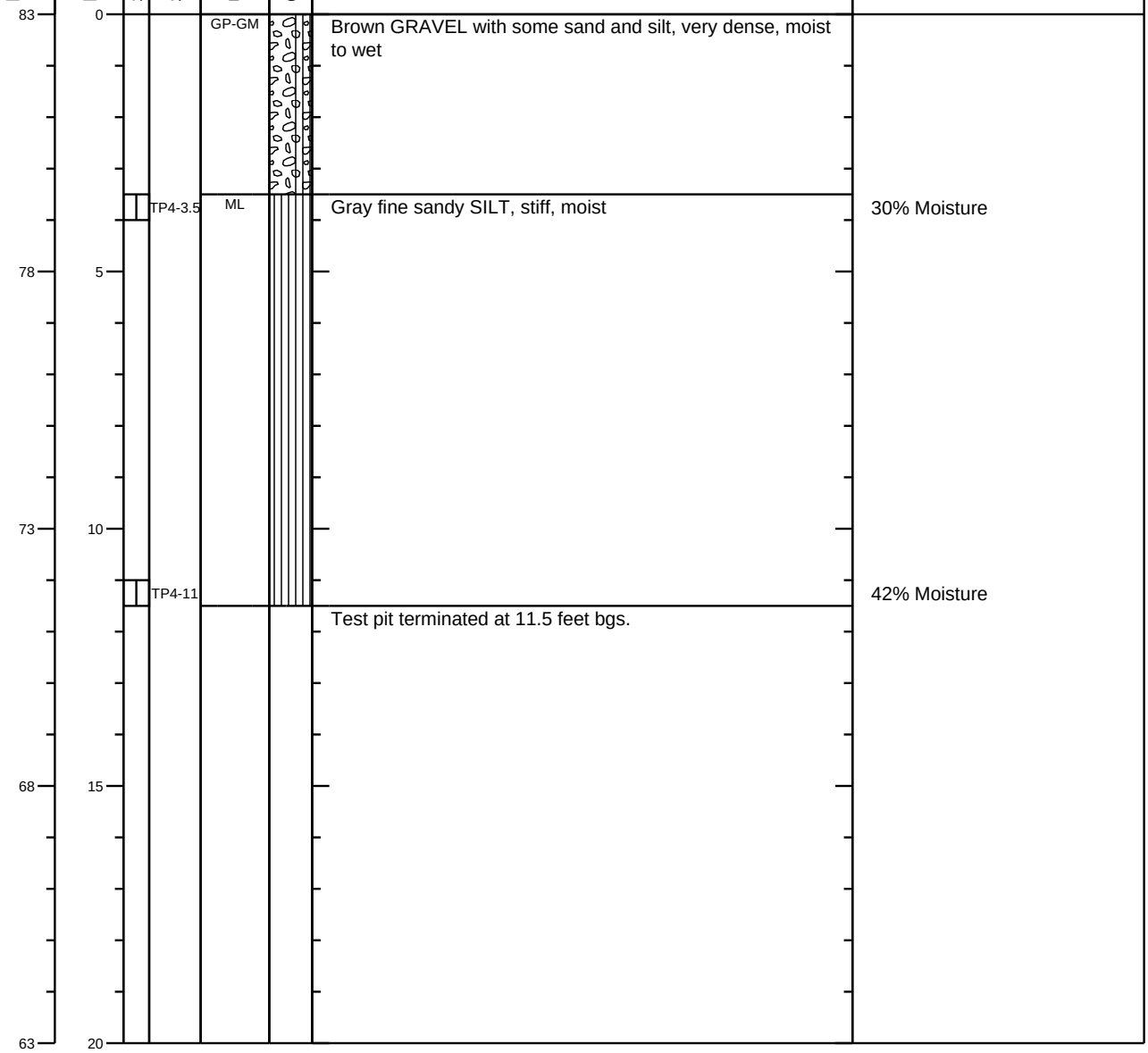
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-4

Sheet 1 of 1

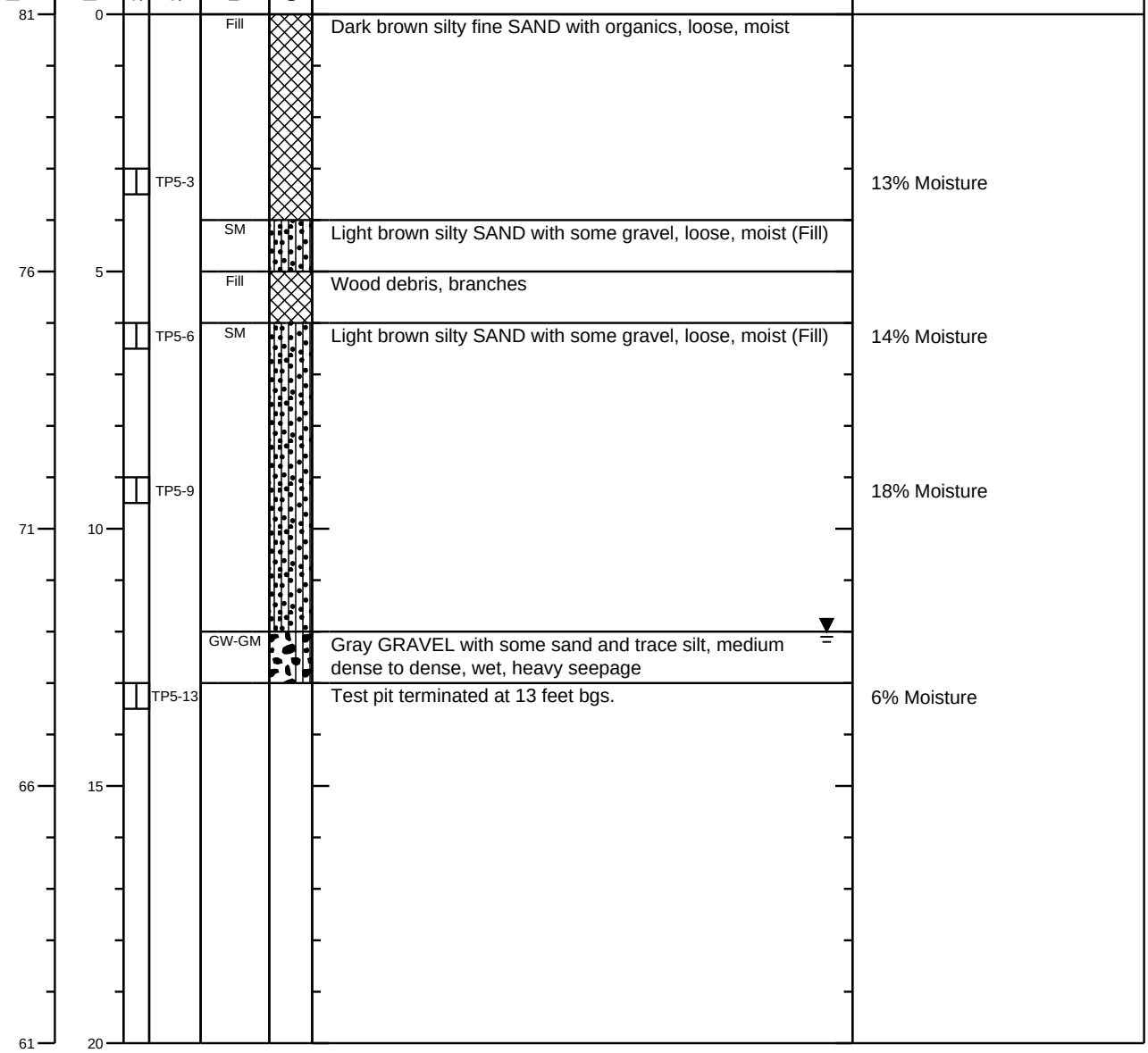
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **83'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-5 **Sheet 1 of 1**

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **13'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **81'**
Groundwater Level: **12'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

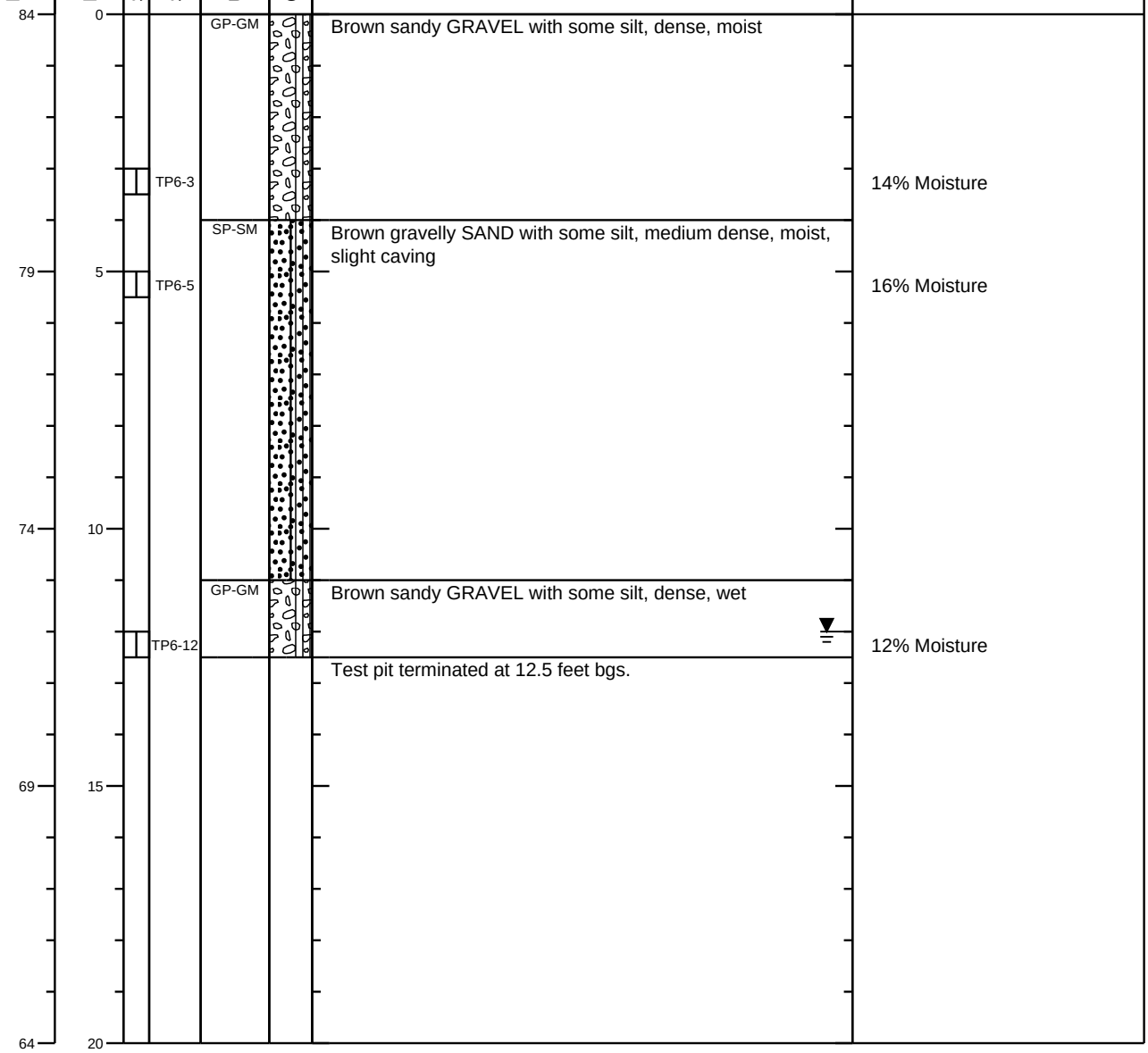
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-6

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **12.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **84'**
Groundwater Level: **12'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

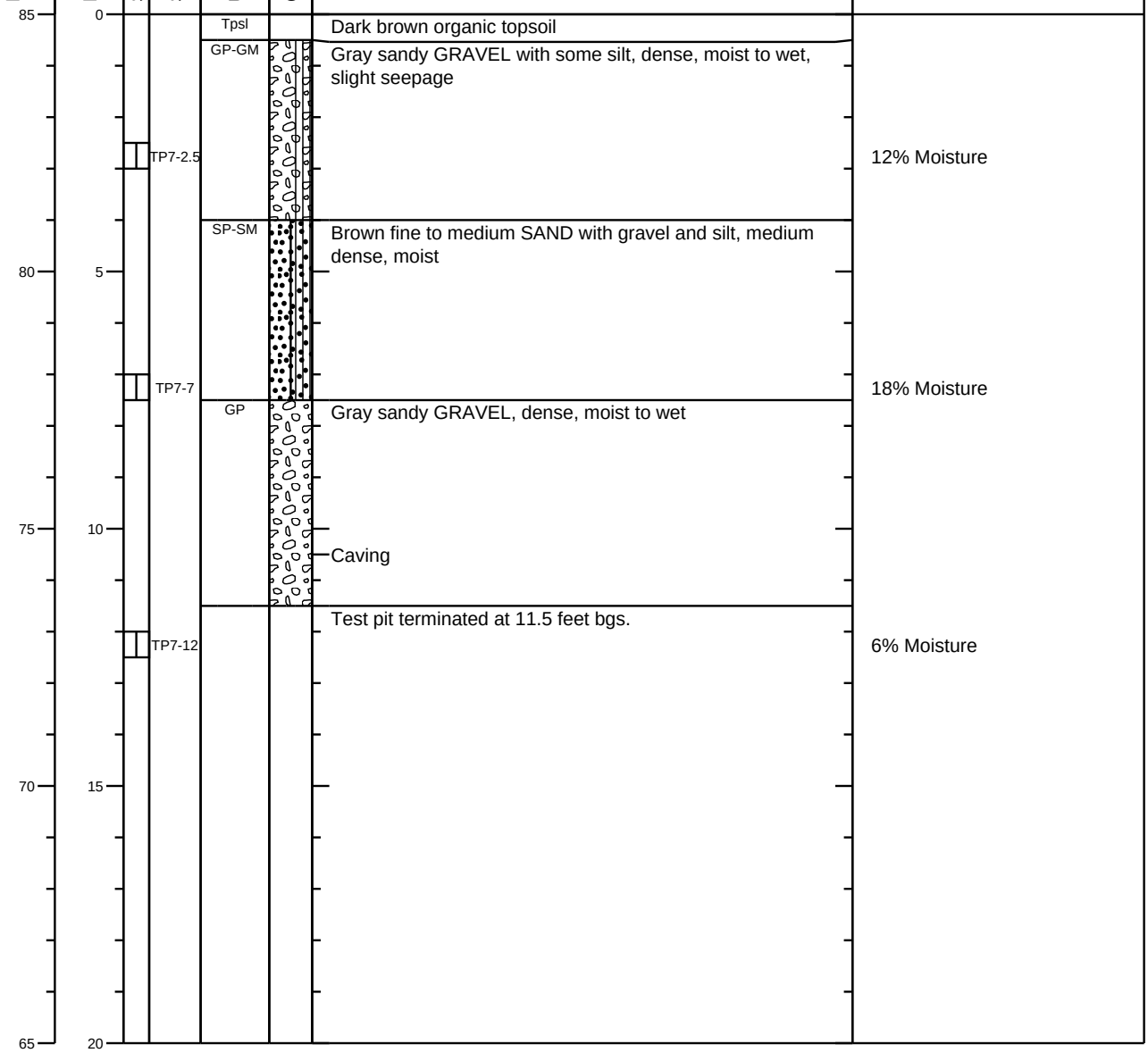
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-7

Sheet 1 of 1

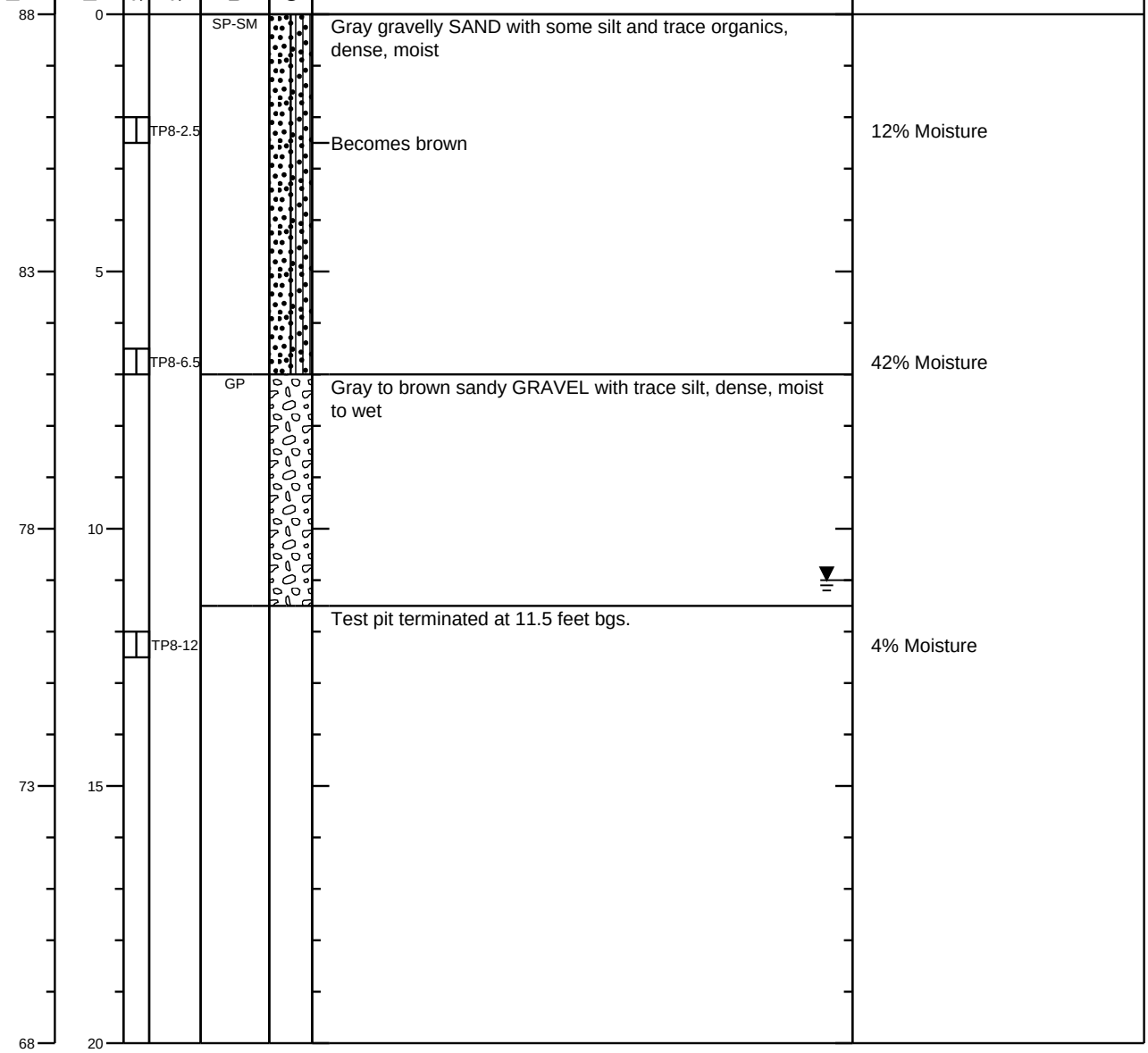
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **85'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-8 **Sheet 1 of 1**

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **88'**
Groundwater Level: **11'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

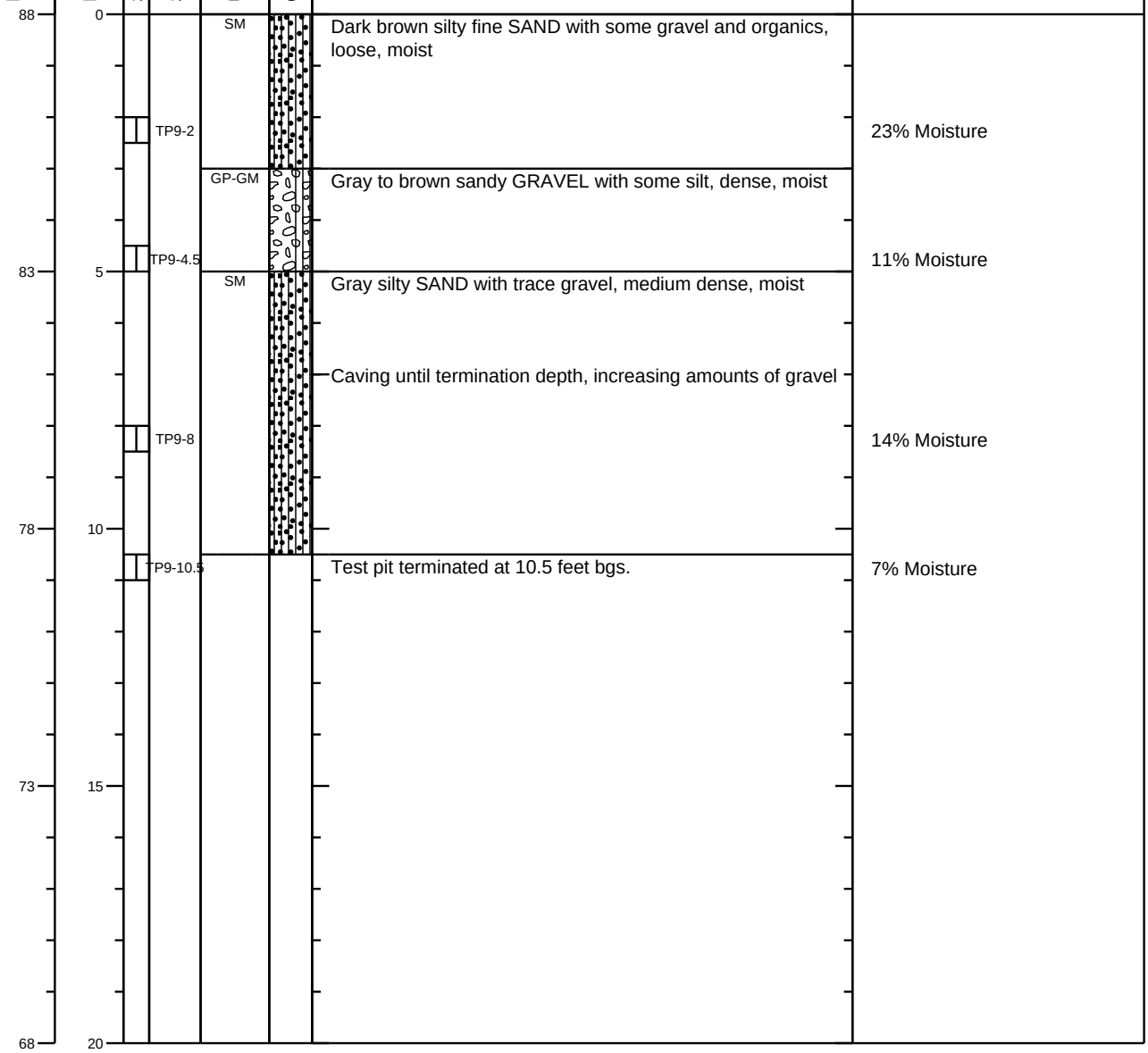
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-9

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **10.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **88'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

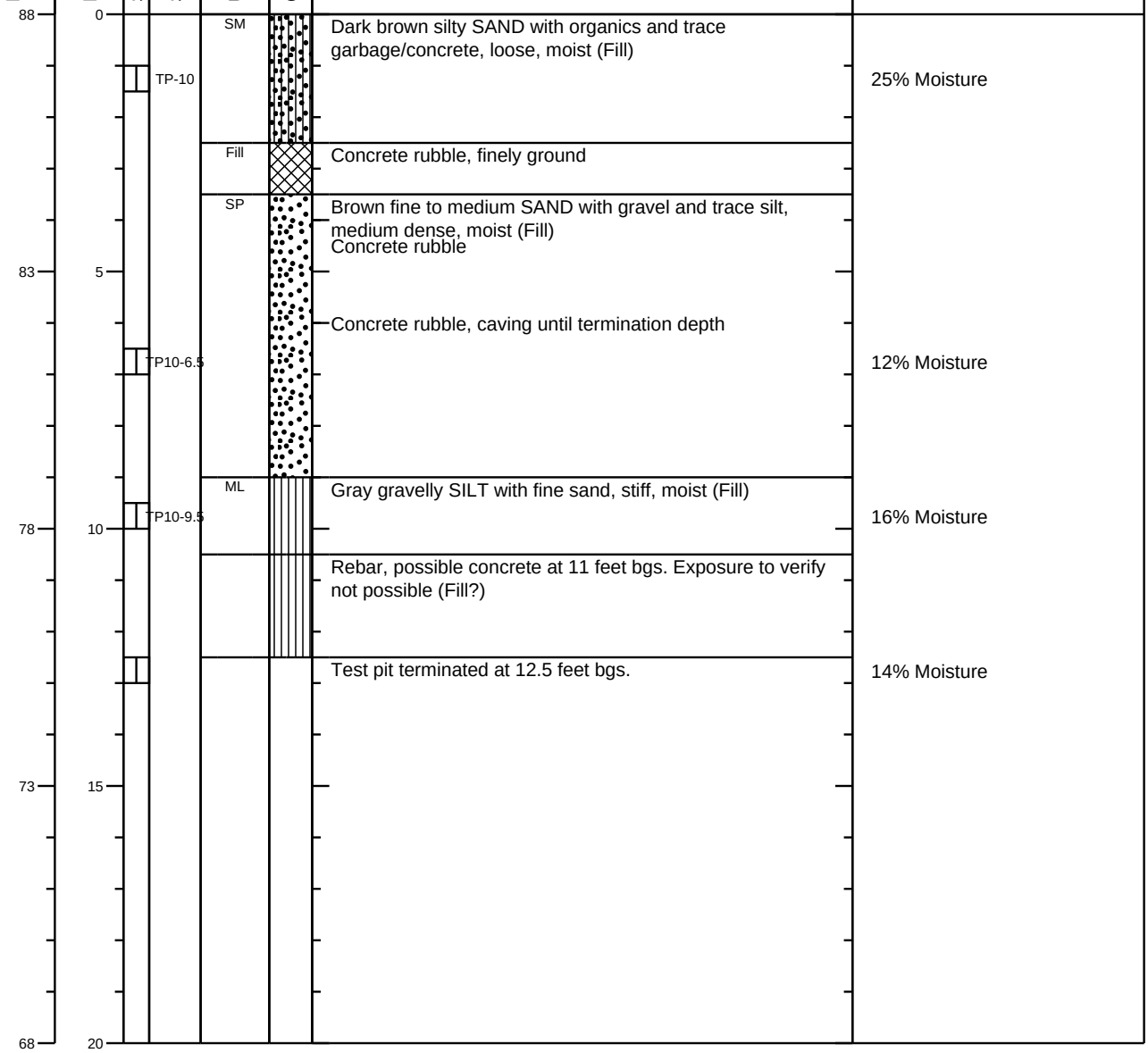
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-10

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **12.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **88'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

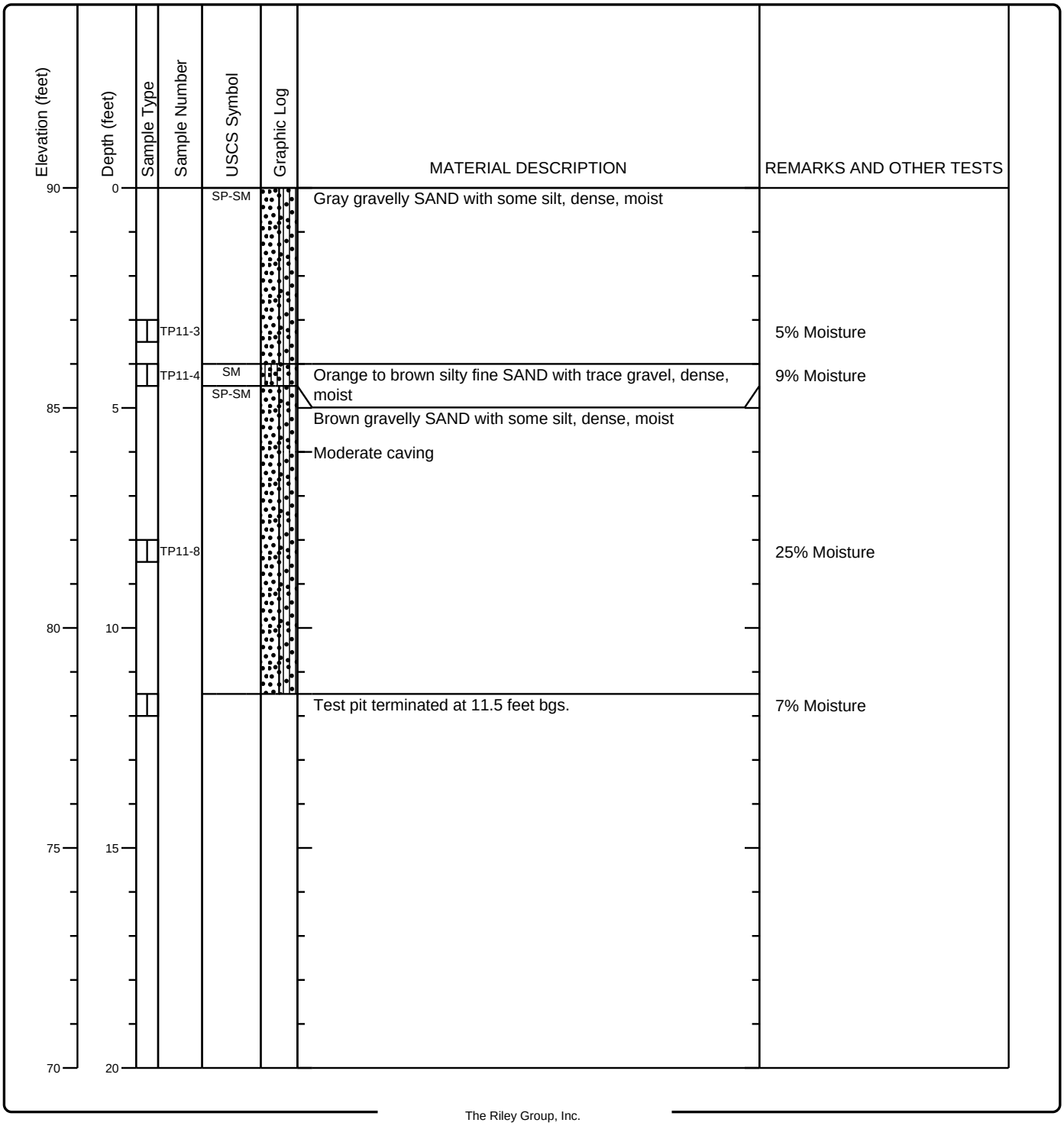
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-11

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **90'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

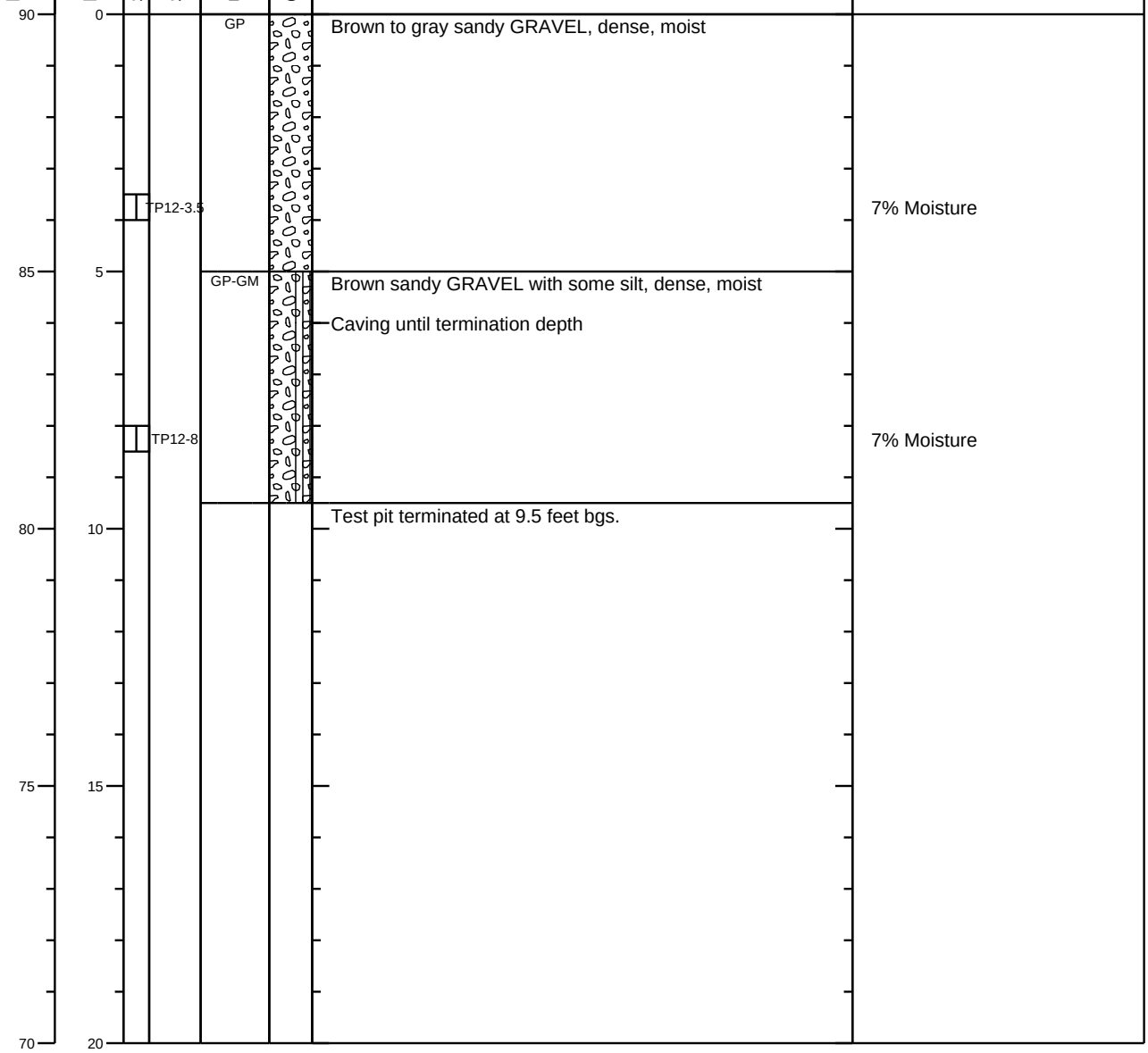
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-12

Sheet 1 of 1

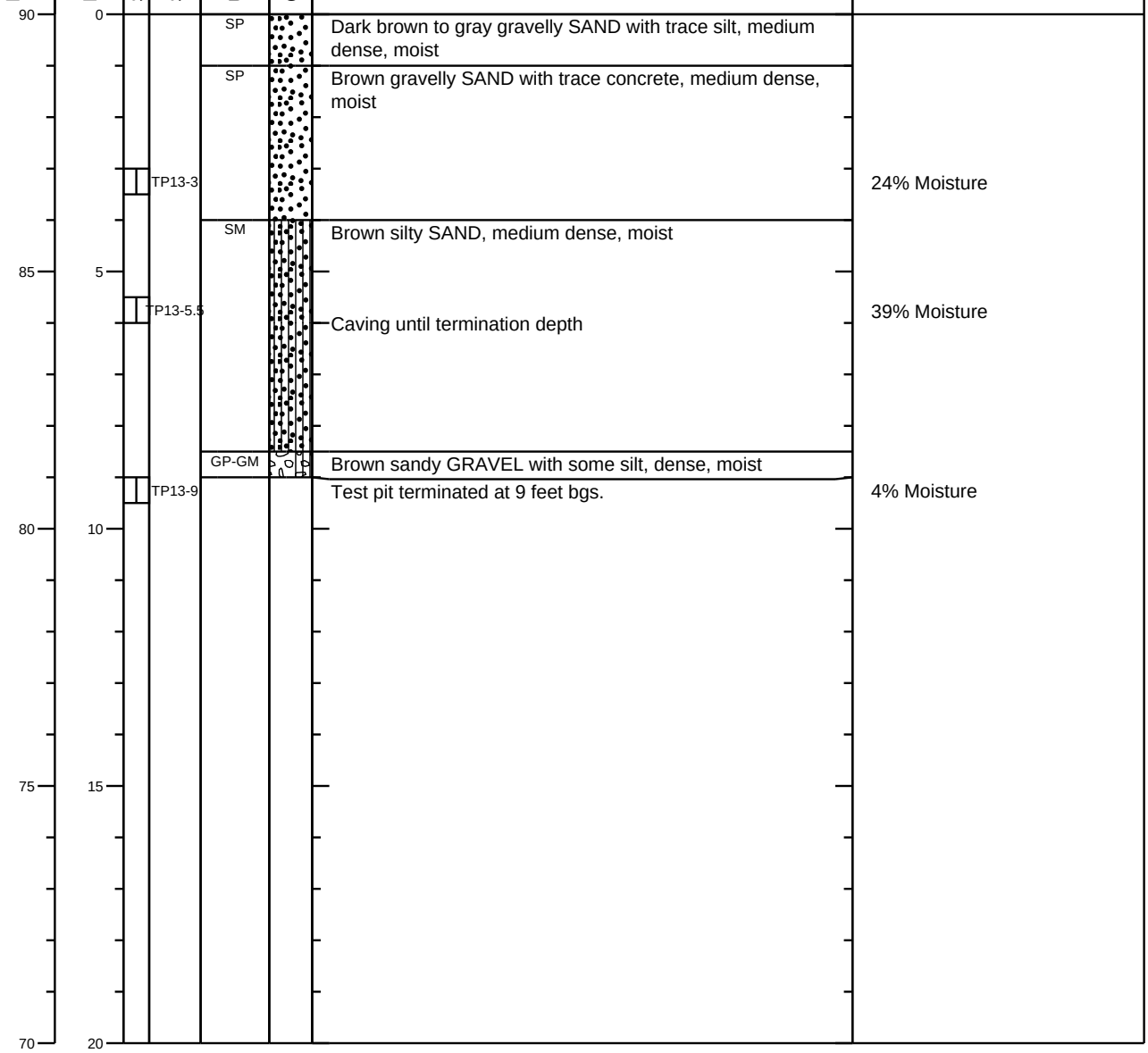
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **9.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **90'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-13 **Sheet 1 of 1**

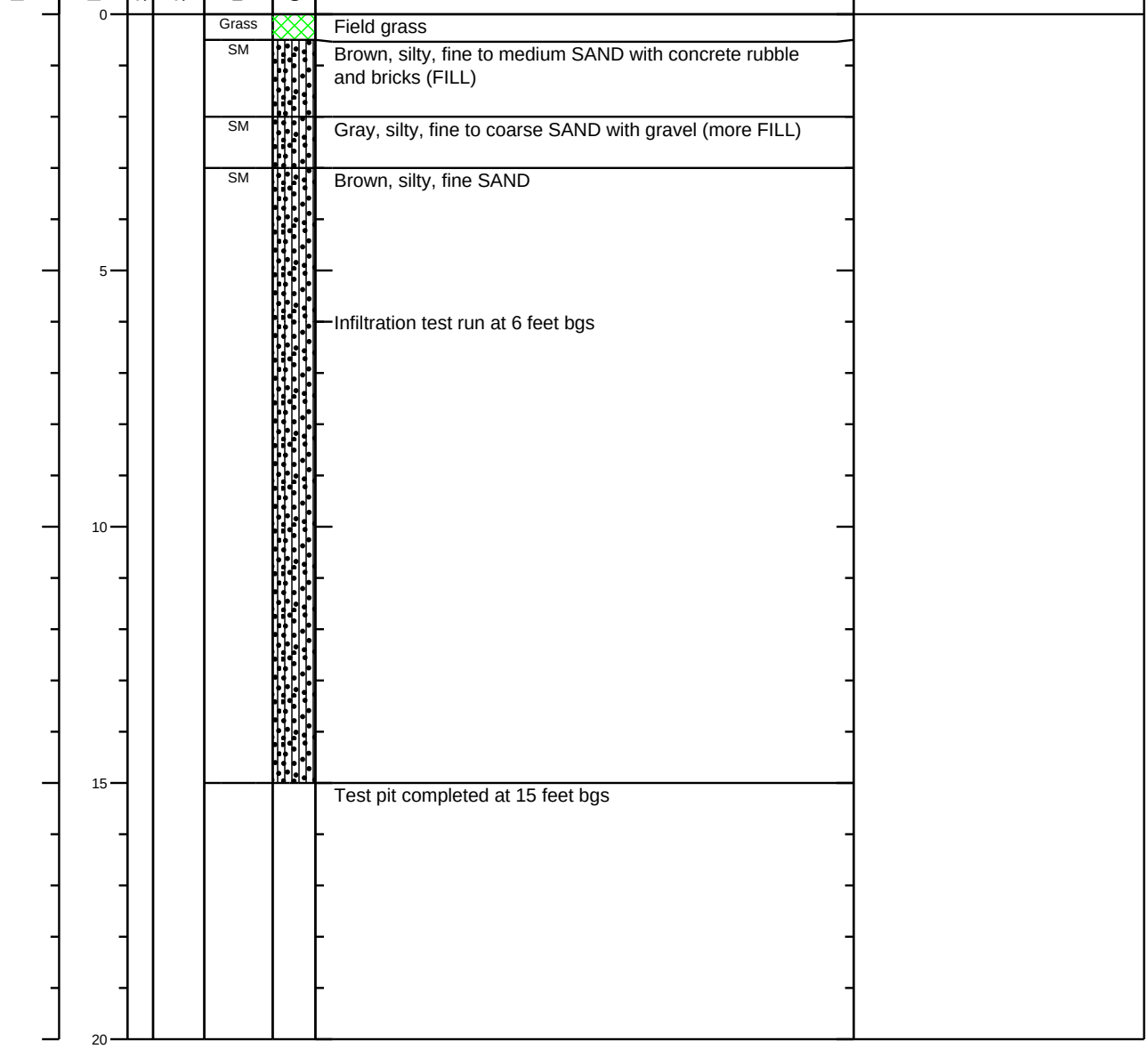
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **9'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **90'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue WA LLC**	RILEYGROUP Test Pit No.: IT-1 **Sheet 1 of 1**

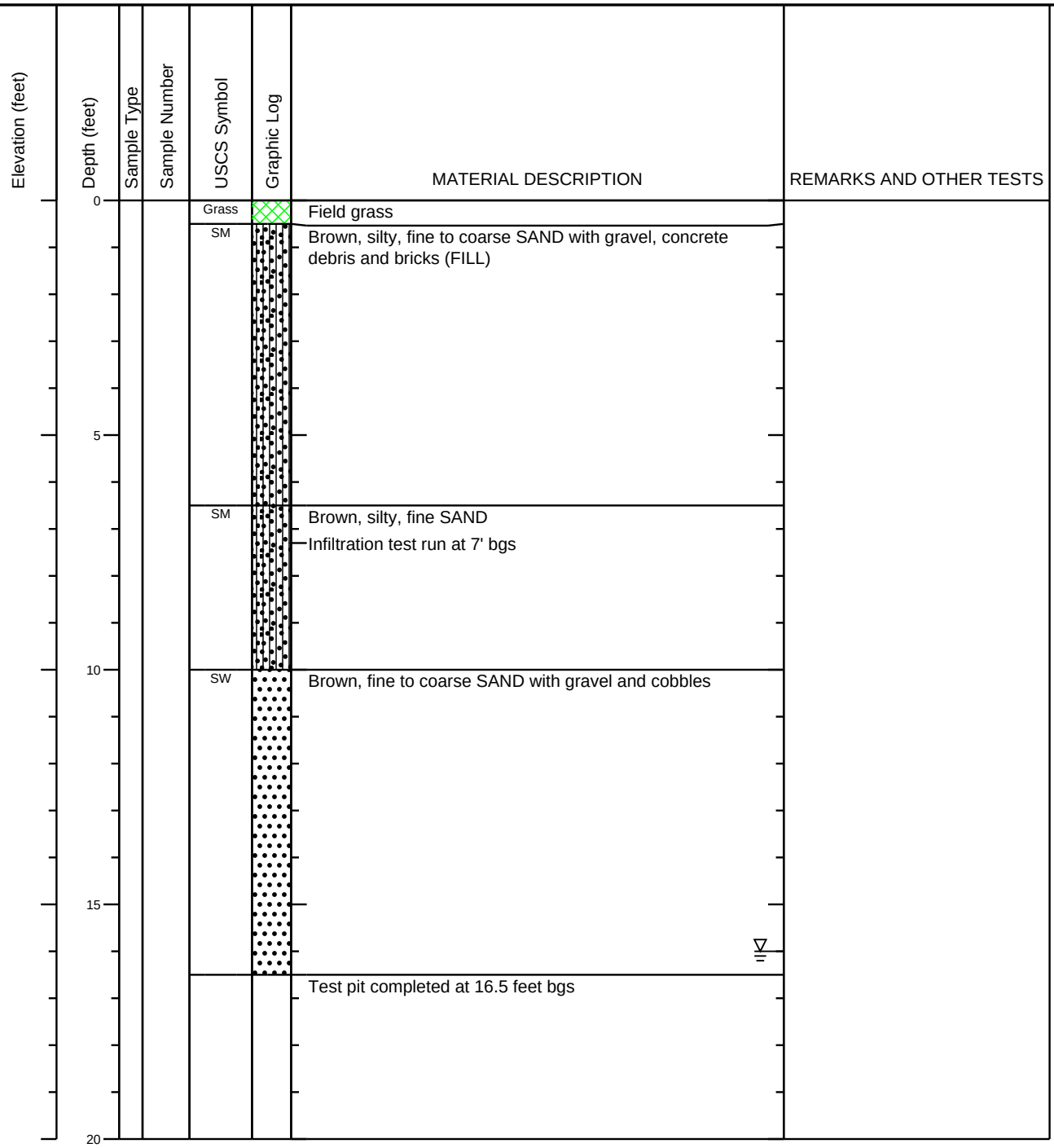
Date(s) Excavated: **07/11/16**	Logged By **DB**	Surface Conditions: **Field Grass**
Excavation Method: **Trackhoe**	Bucket Size: **3.5 Feet**	Total Depth of Excavation: **15 feet bgs**
Excavator Type: **Track-Mounted**	Excavating Contractor: **RGI**	Approximate Surface Elevation **n/a**
Groundwater Level: **Not Encountered**	Sampling Method(s) **n/a**	Compaction Method **Bucket Tamp**
Test Pit Backfill: **Native Soils**	Location **3440 Tolt Avenue, Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue WA LLC**	RILEYGROUP Test Pit No.: IT-2 **Sheet 1 of 1**

Date(s) Excavated: **07/12/16**	Logged By **DB**	Surface Conditions: **Field Grass**
Excavation Method: **Trackhoe**	Bucket Size: **3.5 Feet**	Total Depth of Excavation: **16.5 feet bgs**
Excavator Type: **Track-Mounted**	Excavating Contractor: **RGI**	Approximate Surface Elevation **n/a**
Groundwater Level: **16'**	Sampling Method(s) **n/a**	Compaction Method **Bucket Tamp**
Test Pit Backfill: **Native Soils**	Location **3440 Tolt Avenue, Carnation, Washington 98014**	



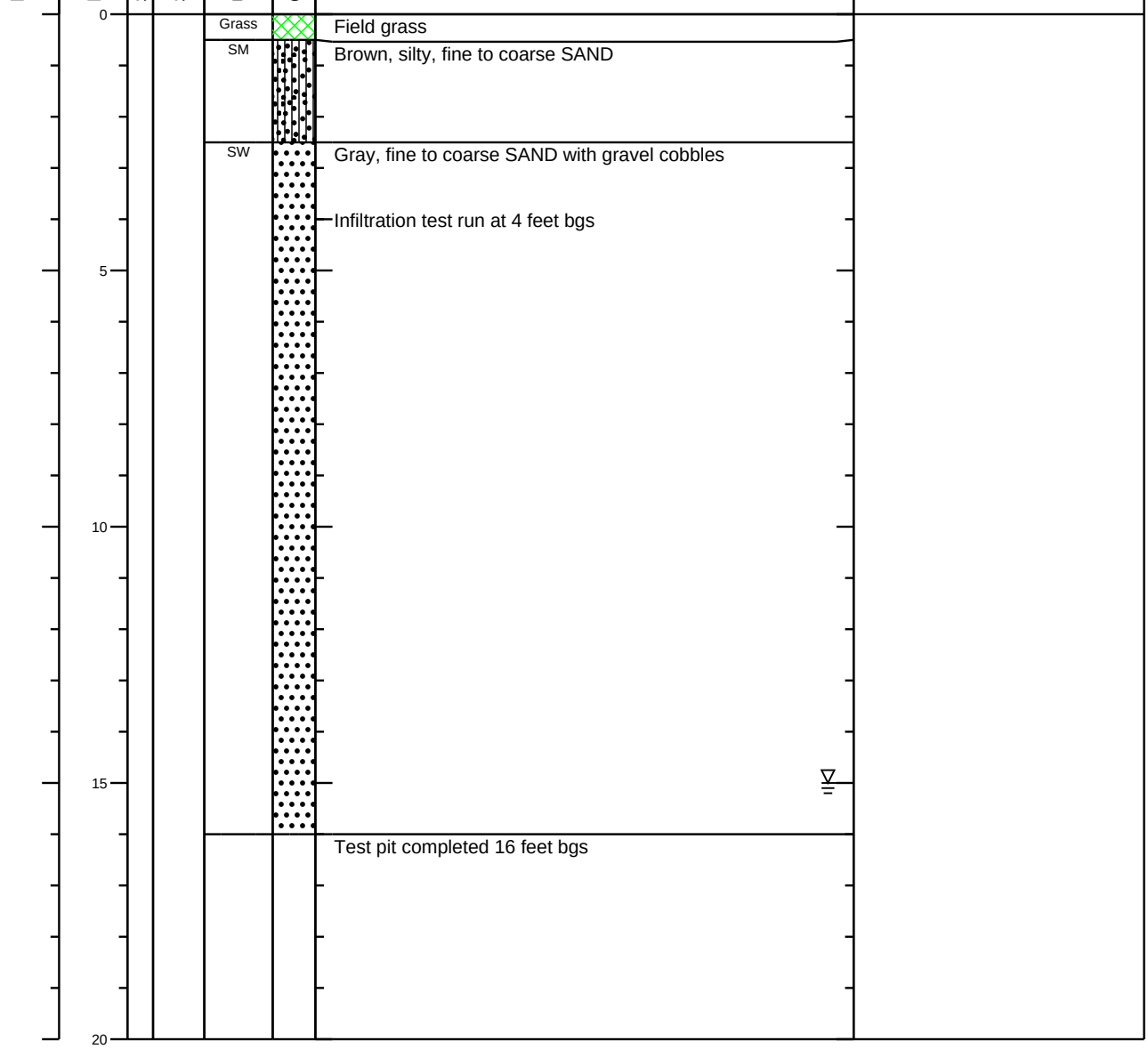
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue WA LLC**

RILEYGROUP

Test Pit No.: IT-3

Sheet 1 of 1

Date(s) Excavated: **07/13/16**	Logged By **DB**	Surface Conditions: **Field Grass**
Excavation Method: **Trackhoe**	Bucket Size: **3.5 Feet**	Total Depth of Excavation: **16 feet bgs**
Excavator Type: **Track-Mounted**	Excavating Contractor: **RGI**	Approximate Surface Elevation **n/a**
Groundwater Level: **15'**	Sampling Method(s) **n/a**	Compaction Method **Bucket Tamp**
Test Pit Backfill: **Native Soils**	Location **3440 Tolt Avenue, Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue WA LLC**

RILEYGROUP

Key to Logs

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample Number: Sample identification number.
5. USCS Symbol: USCS symbol of the subsurface material.
6. Graphic Log: Graphic depiction of the subsurface material encountered.
7. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
8. REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Grass and/or topsoil
Silty SAND (SM)
Well graded SAND (SW)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Continuous
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	MainVue Homes Carnation Property		**SAMPLE ID/TYPE**	TP-1	
PROJECT NO.	2016-115		**SAMPLE DEPTH**	8.5'	
TECH/TEST DATE	CM	12/21/2015	**DATE RECEIVED**	12/17/2015	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	292.6
Wt Dry Soil & Tare (gm)	(w2)	218.8
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	73.8
Weight of Dry Soil (gm)	(w5=w2-w3)	203.2
Moisture Content (%)	(w4/w5)*100	36

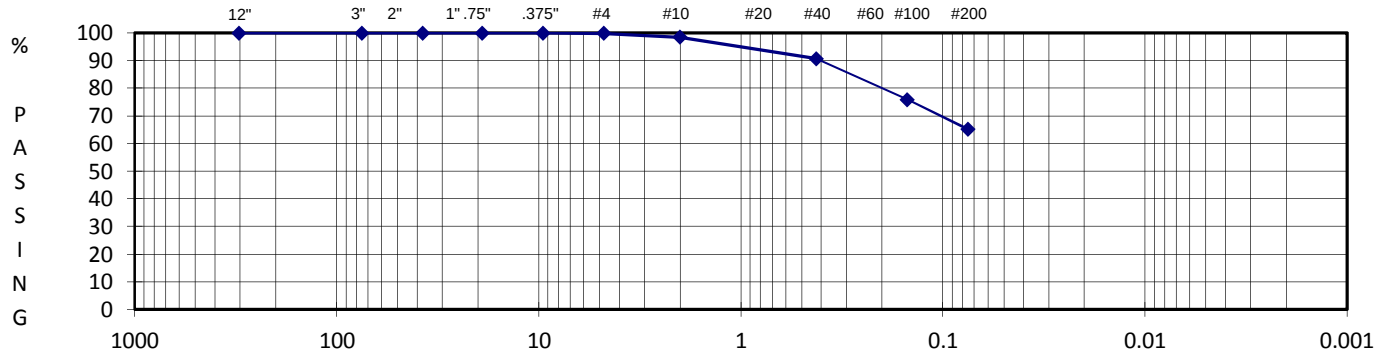
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		218.8
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		203.2

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.1**
% C SAND	**1.4**
% M SAND	**7.7**
% F SAND	**25.6**
% FINES	**65.1**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.6	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.6	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.6	0.00	0.00	100.00	fine gravel
#4	15.9	0.30	0.15	99.85	coarse sand
#10	18.8	3.20	1.57	98.43	medium sand
#20					medium sand
#40	34.5	18.90	9.30	90.70	fine sand
#60					fine sand
#100	64.7	49.10	24.16	75.84	fine sand
#200	86.5	70.90	34.89	65.11	fines
PAN	218.8	203.20	100.00	0.00	silt/clay



DESCRIPTION	Sandy SILT
USCS	ML

Prepared For:
MainVue Homes

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	MainVue Homes Carnation Property		**SAMPLE ID/TYPE**	TP-3	
PROJECT NO.	2016-115		**SAMPLE DEPTH**	7'	
TECH/TEST DATE	CM	12/21/2015	**DATE RECEIVED**	12/17/2015	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	228.6
Wt Dry Soil & Tare (gm)	(w2)	160.7
Weight of Tare (gm)	(w3)	15.7
Weight of Water (gm)	(w4=w1-w2)	67.9
Weight of Dry Soil (gm)	(w5=w2-w3)	145.0
Moisture Content (%)	(w4/w5)*100	47

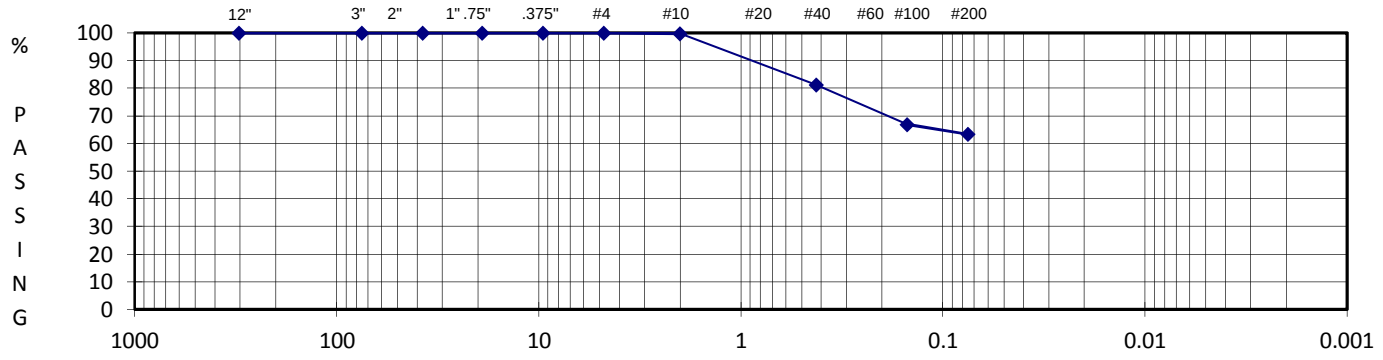
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		160.7
Tare Weight (gm)		15.7
(W6) Total Dry Weight (gm)		145.0

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.0**
% C SAND	**0.3**
% M SAND	**18.6**
% F SAND	**17.9**
% FINES	**63.2**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.7	0.00	0.00	100.00	cobbles
3.0"	15.7	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.7	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.7	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.7	0.00	0.00	100.00	fine gravel
#4	15.7	0.00	0.00	100.00	coarse sand
#10	16.1	0.40	0.28	99.72	medium sand
#20					medium sand
#40	43.0	27.30	18.83	81.17	fine sand
#60					fine sand
#100	63.7	48.00	33.10	66.90	fine sand
#200	69.0	53.30	36.76	63.24	fines
PAN	160.7	145.00	100.00	0.00	silt/clay



DESCRIPTION	Sandy SILT
USCS	ML

Prepared For:
MainVue Homes

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	MainVue Homes Carnation Property		**SAMPLE ID/TYPE**	TP-5	
PROJECT NO.	2016-115		**SAMPLE DEPTH**	6'	
TECH/TEST DATE	CM	12/21/2015	**DATE RECEIVED**	12/17/2015	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	399.7
Wt Dry Soil & Tare (gm)	(w2)	352.0
Weight of Tare (gm)	(w3)	15.7
Weight of Water (gm)	(w4=w1-w2)	47.7
Weight of Dry Soil (gm)	(w5=w2-w3)	336.3
Moisture Content (%)	(w4/w5)*100	14

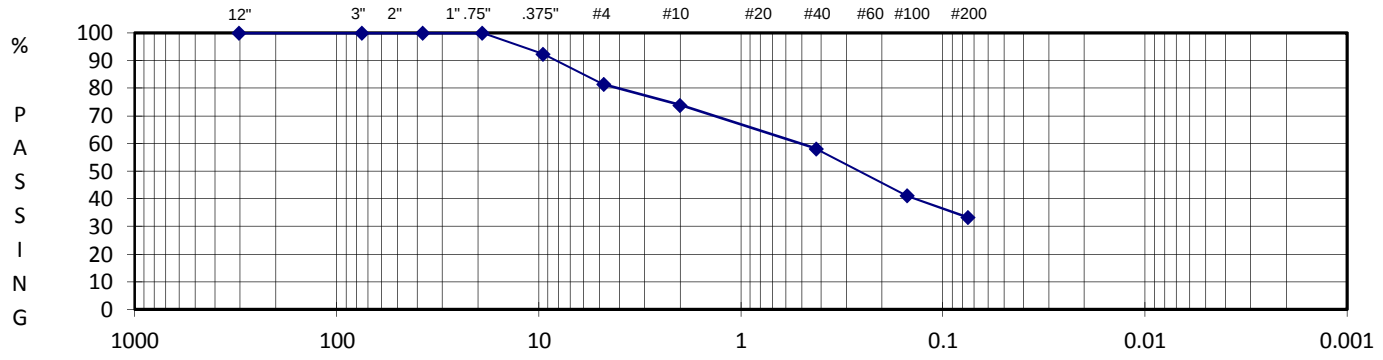
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		352.0
Tare Weight (gm)		15.7
(W6) Total Dry Weight (gm)		336.3

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**18.6**
% C SAND	**7.6**
% M SAND	**15.8**
% F SAND	**24.7**
% FINES	**33.3**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.7	0.00	0.00	100.00	cobbles
3.0"	15.7	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.7	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.7	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	41.6	25.90	7.70	92.30	fine gravel
#4	78.4	62.70	18.64	81.36	coarse sand
#10	103.8	88.10	26.20	73.80	medium sand
#20					medium sand
#40	156.8	141.10	41.96	58.04	fine sand
#60					fine sand
#100	214.2	198.50	59.02	40.98	fine sand
#200	240.0	224.30	66.70	33.30	fines
PAN	352.0	336.30	100.00	0.00	silt/clay



DESCRIPTION	Silty SAND with some gravel
USCS	SM

Prepared For:
MainVue Homes

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	MainVue Homes Carnation Property		**SAMPLE ID/TYPE**	TP-5	
PROJECT NO.	2016-115		**SAMPLE DEPTH**	13'	
TECH/TEST DATE	CM	12/21/2015	**DATE RECEIVED**	12/17/2015	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1415.9
Wt Dry Soil & Tare (gm)	(w2)	1337.8
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	78.1
Weight of Dry Soil (gm)	(w5=w2-w3)	1322.2
Moisture Content (%)	(w4/w5)*100	6

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

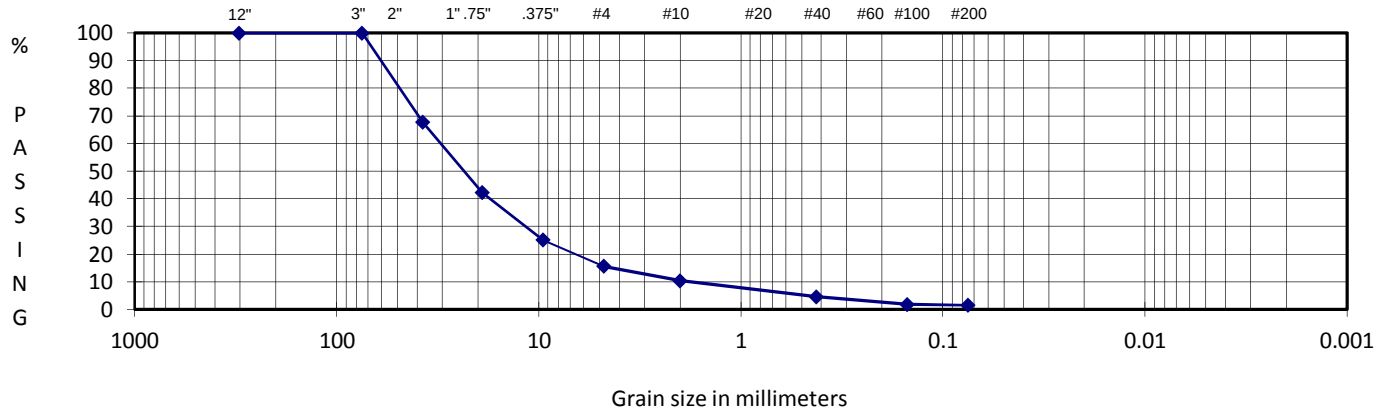
Weight Of Sample (gm)		1337.8
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		1322.2

% COBBLES	**0.0**
% C GRAVEL	**57.9**
% F GRAVEL	**26.6**
% C SAND	**5.3**
% M SAND	**5.7**
% F SAND	**3.1**
% FINES	**1.4**
% TOTAL	**100.0**

D10 (mm)	2
D30 (mm)	12
D60 (mm)	31
Cu	15.5
Cc	2.3

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	443.8	428.20	32.39	67.61	coarse gravel
1.0"					coarse gravel
0.75"	780.5	764.90	57.85	42.15	fine gravel
0.50"					fine gravel
0.375"	1007.1	991.50	74.99	25.01	fine gravel
#4	1131.8	1116.20	84.42	15.58	coarse sand
#10	1201.5	1185.90	89.69	10.31	medium sand
#20					medium sand
#40	1277.5	1261.90	95.44	4.56	fine sand
#60					fine sand
#100	1313.6	1298.00	98.17	1.83	fine sand
#200	1319.1	1303.50	98.59	1.41	fines
PAN	1337.8	1322.20	100.00	0.00	silt/clay



DESCRIPTION GRAVEL with some sand and trace silt

USCS GW-GM

Prepared For:
MainVue Homes

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	MainVue Homes Carnation Property		**SAMPLE ID/TYPE**	TP-9	
PROJECT NO.	2016-115		**SAMPLE DEPTH**	8'	
TECH/TEST DATE	CM	12/21/2015	**DATE RECEIVED**	12/17/2015	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	490.5
Wt Dry Soil & Tare (gm)	(w2)	431.5
Weight of Tare (gm)	(w3)	16.0
Weight of Water (gm)	(w4=w1-w2)	59.0
Weight of Dry Soil (gm)	(w5=w2-w3)	415.5
Moisture Content (%)	(w4/w5)*100	14

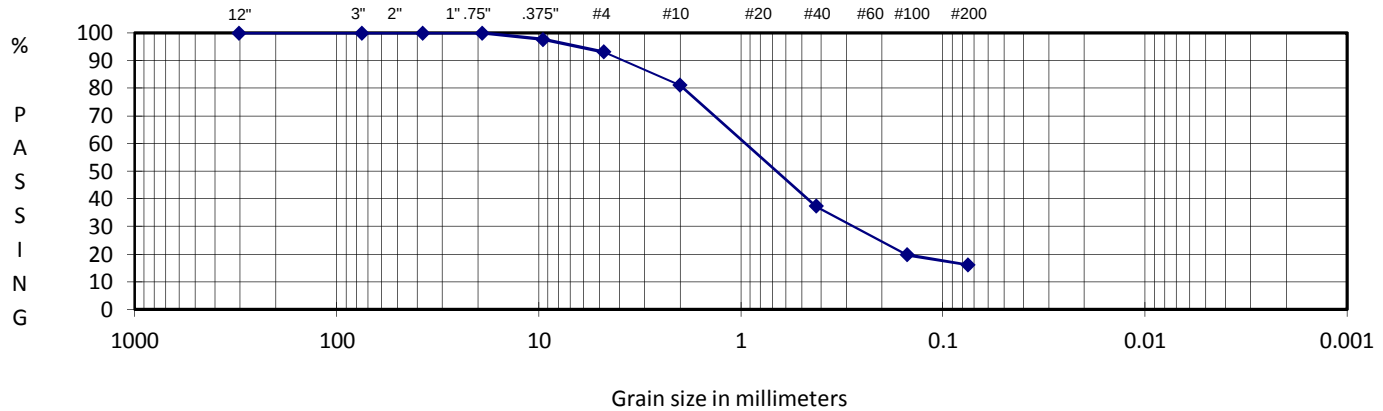
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		431.5
Tare Weight (gm)		16.0
(W6) Total Dry Weight (gm)		415.5

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**6.9**
% C SAND	**12.0**
% M SAND	**43.8**
% F SAND	**21.2**
% FINES	**16.2**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.0	0.00	0.00	100.00	cobbles
3.0"	16.0	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	16.0	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	16.0	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	25.9	9.90	2.38	97.62	fine gravel
#4	44.7	28.70	6.91	93.09	coarse sand
#10	94.4	78.40	18.87	81.13	medium sand
#20					medium sand
#40	276.3	260.30	62.65	37.35	fine sand
#60					fine sand
#100	349.6	333.60	80.29	19.71	fine sand
#200	364.3	348.30	83.83	16.17	fines
PAN	431.5	415.50	100.00	0.00	silt/clay



DESCRIPTION	Silty SAND with trace gravel
USCS	SM

Prepared For:
MainVue Homes

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	MainVue Homes Carnation Property		**SAMPLE ID/TYPE**	TP-12	
PROJECT NO.	2016-115		**SAMPLE DEPTH**	8'	
TECH/TEST DATE	CM	12/21/2015	**DATE RECEIVED**	12/17/2015	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	518.2
Wt Dry Soil & Tare (gm)	(w2)	483.5
Weight of Tare (gm)	(w3)	14.4
Weight of Water (gm)	(w4=w1-w2)	34.7
Weight of Dry Soil (gm)	(w5=w2-w3)	469.1
Moisture Content (%)	(w4/w5)*100	7

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

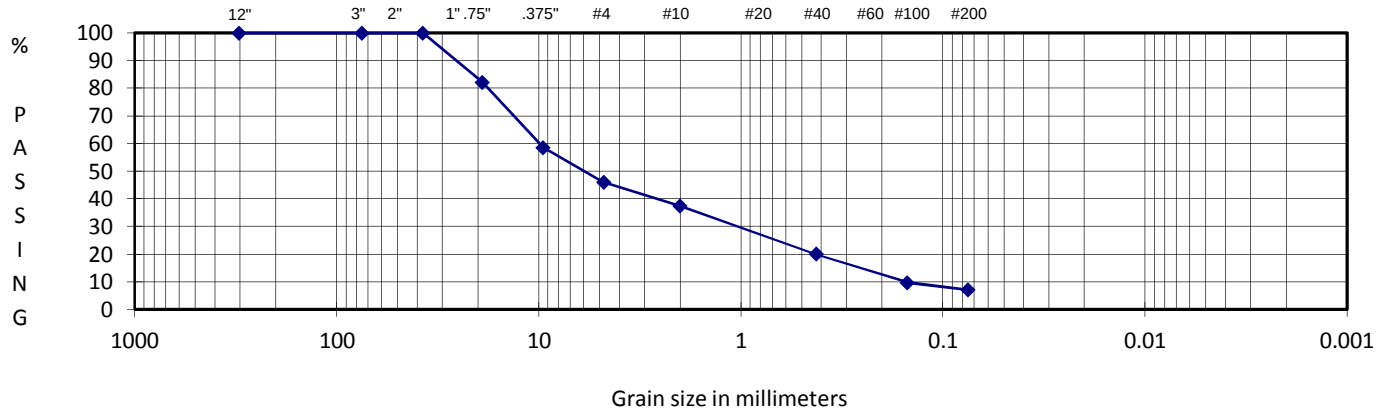
Weight Of Sample (gm)		483.5
Tare Weight (gm)		14.4
(W6) Total Dry Weight (gm)		469.1

% COBBLES	**0.0**
% C GRAVEL	**17.9**
% F GRAVEL	**36.3**
% C SAND	**8.5**
% M SAND	**17.3**
% F SAND	**13.0**
% FINES	**7.0**
% TOTAL	**100.0**

D10 (mm)	0.16
D30 (mm)	1
D60 (mm)	10
Cu	62.5
Cc	0.6

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	14.4	0.00	0.00	100.00	cobbles
3.0"	14.4	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	14.4	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	98.2	83.80	17.86	82.14	fine gravel
0.50"					fine gravel
0.375"	209.3	194.90	41.55	58.45	fine gravel
#4	268.3	253.90	54.12	45.88	coarse sand
#10	308.4	294.00	62.67	37.33	medium sand
#20					medium sand
#40	389.7	375.30	80.00	20.00	fine sand
#60					fine sand
#100	438.2	423.80	90.34	9.66	fine sand
#200	450.6	436.20	92.99	7.01	fines
PAN	483.5	469.10	100.00	0.00	silt/clay



DESCRIPTION	Sandy GRAVEL with some silt
USCS	GP-GM

Prepared For:
MainVue Homes

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mainvue Homes Carnation Property		**SAMPLE ID/TYPE**	IT-1	
PROJECT NO.	2016-115		**SAMPLE DEPTH**		
TECH/TEST DATE	ELW 7/24/2016		**DATE RECEIVED**	7/21/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	675.3
Wt Dry Soil & Tare (gm)	(w2)	535.9
Weight of Tare (gm)	(w3)	15.7
Weight of Water (gm)	(w4=w1-w2)	139.4
Weight of Dry Soil (gm)	(w5=w2-w3)	520.2
Moisture Content (%)	(w4/w5)*100	27

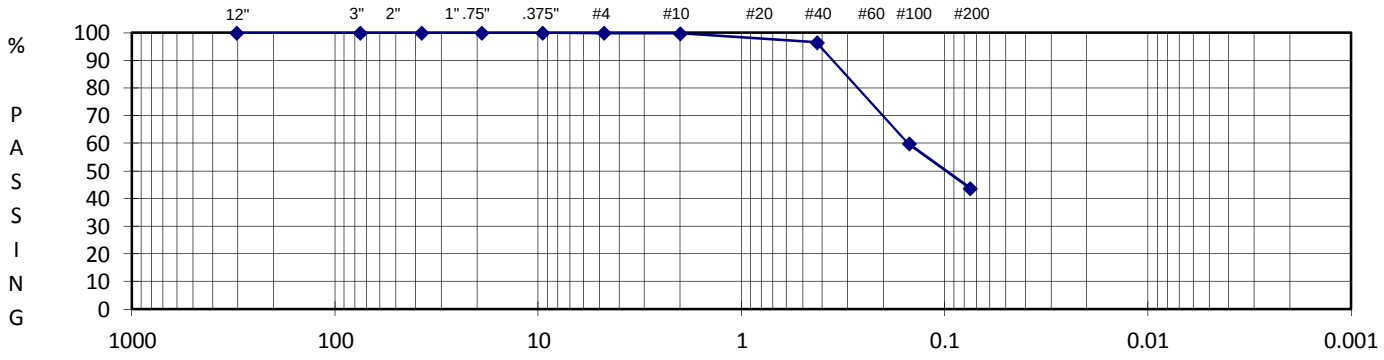
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		535.9
Tare Weight (gm)		15.7
(W6) Total Dry Weight (gm)		520.2

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.2**
% C SAND	**0.1**
% M SAND	**3.2**
% F SAND	**52.7**
% FINES	**43.7**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.7	0.00	0.00	100.00	cobbles
3.0"	15.7	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.7	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.7	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.7	0.00	0.00	100.00	fine gravel
#4	16.8	1.10	0.21	99.79	coarse sand
#10	17.1	1.40	0.27	99.73	medium sand
#20					medium sand
#40	34.0	18.30	3.52	96.48	fine sand
#60					fine sand
#100	224.8	209.10	40.20	59.80	fine sand
#200	308.4	292.70	56.27	43.73	fines
PAN	535.9	520.20	100.00	0.00	silt/clay



DESCRIPTION Silty fine SAND

USCS SM

Prepared For:

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mainvue Homes Carnation Property		**SAMPLE ID/TYPE**	IT-2	
PROJECT NO.	2016-115		**SAMPLE DEPTH**		
TECH/TEST DATE	ELW 7/24/2016		**DATE RECEIVED**	7/21/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	862.8
Wt Dry Soil & Tare (gm)	(w2)	704.8
Weight of Tare (gm)	(w3)	15.5
Weight of Water (gm)	(w4=w1-w2)	158.0
Weight of Dry Soil (gm)	(w5=w2-w3)	689.3
Moisture Content (%)	(w4/w5)*100	23

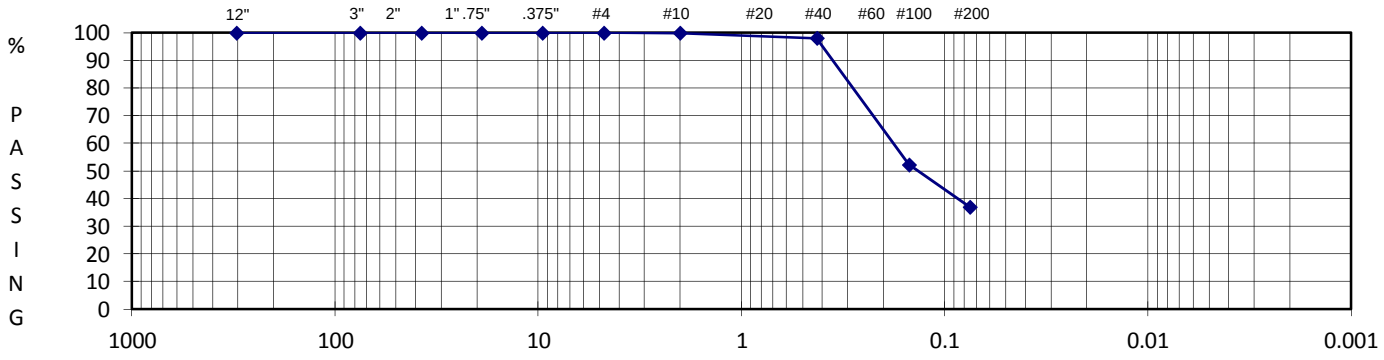
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		704.8
Tare Weight (gm)		15.5
(W6) Total Dry Weight (gm)		689.3

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.1**
% C SAND	**0.0**
% M SAND	**1.8**
% F SAND	**61.2**
% FINES	**36.8**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.5	0.00	0.00	100.00	cobbles
3.0"	15.5	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.5	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.5	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.5	0.00	0.00	100.00	fine gravel
#4	16.2	0.70	0.10	99.90	coarse sand
#10	16.5	1.00	0.15	99.85	medium sand
#20					medium sand
#40	29.1	13.60	1.97	98.03	fine sand
#60					fine sand
#100	344.7	329.20	47.76	52.24	fine sand
#200	451.0	435.50	63.18	36.82	fines
PAN	704.8	689.30	100.00	0.00	silt/clay



DESCRIPTION	Silty fine SAND
USCS	SM

Prepared For:

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mainvue Homes Carnation Property		**SAMPLE ID/TYPE**	IT-3	
PROJECT NO.	2016-115		**SAMPLE DEPTH**		
TECH/TEST DATE	ELW 7/24/2016		**DATE RECEIVED**	7/21/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1476.5
Wt Dry Soil & Tare (gm)	(w2)	1443.6
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	32.9
Weight of Dry Soil (gm)	(w5=w2-w3)	1428.0
Moisture Content (%)	(w4/w5)*100	2

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

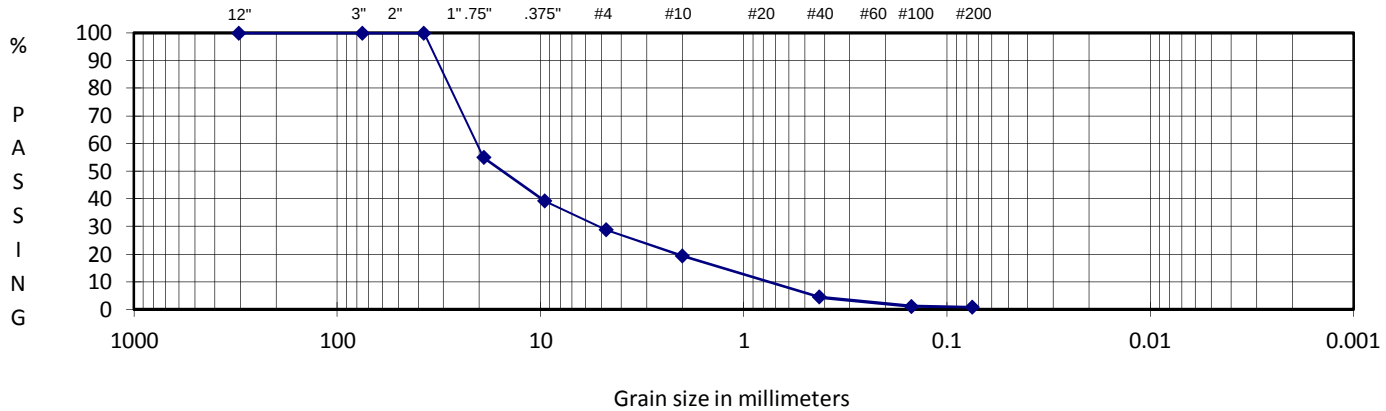
Weight Of Sample (gm)		1443.6
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		1428.0

% COBBLES	**0.0**
% C GRAVEL	**45.1**
% F GRAVEL	**26.1**
% C SAND	**9.4**
% M SAND	**14.9**
% F SAND	**3.7**
% FINES	**0.7**
% TOTAL	**100.0**

D10 (mm)	0.8
D30 (mm)	5
D60 (mm)	20
Cu	25.0
Cc	1.6

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.6	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	660.0	644.40	45.13	54.87	fine gravel
0.50"					fine gravel
0.375"	884.5	868.90	60.85	39.15	fine gravel
#4	1033.3	1017.70	71.27	28.73	coarse sand
#10	1167.7	1152.10	80.68	19.32	medium sand
#20					medium sand
#40	1379.9	1364.30	95.54	4.46	fine sand
#60					fine sand
#100	1427.5	1411.90	98.87	1.13	fine sand
#200	1433.2	1417.60	99.27	0.73	fines
PAN	1443.6	1428.00	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with some sand and trace silt
USCS	GW

Prepared For:

Reviewed By: KMW

RILEYGROUP

7.2

Stormwater Infiltration Evaluation prepared by The Riley Group, Inc. dated January 23, 2017

STORMWATER INFILTRATION EVALUATION

PREPARED BY:

THE RILEY GROUP, INC.
17522 BOTHELL WAY NORTHEAST
BOTHELL, WASHINGTON 98011

PREPARED FOR:

MAINVUE HOMES
1110 112TH AVENUE NORTHEAST, SUITE 202
BELLEVUE, WASHINGTON 98004

RGI PROJECT NO. 2016-115

CARNATION WASHINGTON PROPERTY
KING COUNTY TAX PARCELS 2125079035, 2125079062, AND 2125079063
CARNATION, WASHINGTON

JANUARY 23, 2017

Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone 425.415.0551 ♦ Fax 425.415.0311

www.riley-group.com

RILEYGROUP

January 23, 2017

Barbara Yarington
MainVue Homes
1110 112th Avenue Northeast, Suite 202
Bellevue, Washington 98004

Subject: **Stormwater Infiltration Evaluation**
Carnation Washington Property
King County Tax Parcels 2125079035, 2125079062, and 2125079063
Carnation, Washington
RGI Project No. 2016-115

Dear Ms. Yarington:

As requested, The Riley Group, Inc. (RGI) has performed a Stormwater Infiltration Evaluation for MainVue Homes site in Carnation, Washington (herein referred to as the Site). Our services were completed in accordance with our proposal PRP2016-209 dated June 29, 2016 and PRP2016-209A, dated December 20, 2016 and authorized by Barbara Yarington with MainVue Homes on July 1, 2016 and January 3, 2017. The information in this report is based on our understanding of the proposed stormwater management plan and the soil and groundwater conditions encountered in the infiltration test pits completed by RGI at the Site in July 2016 and January 2317.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

THE RILEY GROUP, INC.

State of Washington
Hydrogeologist
1079
Licensed Geologist
1/23/17
David J. Baumgarten

David J. Baumgarten, L.H.G.
Senior Hydrogeologist

RICKY RUNQI WANG
STATE OF WASHINGTON
35013
REGISTERED
PROFESSIONAL ENGINEER
1/23/2017

Ricky R. Wang, PhD, PE
Principal Engineer

Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone 425.415.0551 ♦ Fax 425.415.0311

www.riley-group.com

1.0 Introduction

The purpose of this evaluation was to assess subsurface conditions in regard to the potential to infiltrate stormwater at the Site. RGI understands the proposed Site development plan under evaluation is single-family detached homes and associated utilities including potential stormwater detention or infiltration facilities. RGI's understanding of the project is based on a meetings and conversations with MainVue Homes.

2.0 Site Description

The Site is comprised of three tax parcels King County Tax Parcels 2125079035, 2125079062, and 2125079063, which correlate to 3700, 3660, and 3440 Tolt Avenue, in Carnation, Washington. The approximate location of the Site is shown on Figure 1.

The Site is currently occupied by graveled industrial storage space on Parcels 2120799063 and 2125079035 and several industrial buildings and graveled storage space on Parcel 2120799062. Three large stormwater ponds are located on the southern portion of the Site (Figure 2). Two stormwater ponds are located on the southern portion of Parcel 2125079063. The third stormwater pond is located on the southern portion of Parcel 2125079062.

We understand the three stormwater ponds were dug by the Site owners in the late 1990's and the excavated material from the ponds was used as fill in the area north of the ponds.

2.1 Field Exploration

On July 11, 12, and 13, 2016 and January 12, 2017 RGI oversaw the completion of four infiltration tests IT-1, IT-2, IT-3, and IT-4 in the channel migration zone on the southern portion of the Site (Figure 2). Infiltration test locations were selected to evaluate infiltration rates and assess the feasibility of stormwater infiltration under the proposed site development. We also completed a test pit TP-14 in the area proposed for potential stormwater infiltration (Figure 2). Soil samples of the potential infiltration receptor soils in infiltration test pit IT-4 and in test pit TP-14 were collected for grain size analysis and analysis of the cation exchange capacity (CEC) and organic content.

Infiltration test were conducted using a modified pilot infiltration test (PIT) methodology. An excavation was made in the infiltration test location and then water was introduced into the pit. A water level between 0.5 and 1 foot was maintained in the infiltration test pit during the pre-soak period. The infiltration rates were measured under falling head conditions after the constant head rate stabilized during the pre-soak period. Soil logs of subsurface conditions encountered in infiltration test IT-1, IT-2, IT-3, and IT-4 are included in Attachment A.

Infiltration Test IT-1

Infiltration test IT-1 was completed in July 2016, in the channel migration zone north of the berm between the two easternmost ponds (Figure 2). Subsurface conditions at the IT-1 location consist of approximately 3 to 3.5 feet of fill underlain by brown silty fine sand. The fill soils are comprised of brown silty fine sand with concrete rubble and bricks from ground surface to a depth of approximately 2 feet, underlain by 1 to 1.5 feet of gray silty fine to coarse sand that may be lodgment till fill.

Infiltration test IT-1 was conducted at a depth of approximately 6 feet below grade in the native brown silty fine sand. The field infiltration rate measured in IT-1 was 1/4 inch/hour. The infiltration test IT-1 pit was overexcavated at the end of the infiltration test. Subsurface conditions included silty fine sand to the depth excavated, approximately 15 feet below grade. Groundwater was not encountered.

Infiltration Test IT-2

Infiltration test IT-2 was completed in July 2016, in the channel migration zone north of the eastern boundary of the easternmost stormwater pond (Figure 2). Subsurface conditions at the IT-2 location consist of approximately 6.5 feet of fill underlain by brown silty fine sand. The fill soils are comprised of brown silty fine to coarse sand with gravel, concrete rubble and bricks.

Infiltration test IT-2 was conducted at a depth of approximately 7 feet below grade in the native brown silty fine sand. The field infiltration rate measured in IT-2 was 8 inches/hour. The infiltration test IT-2 pit was overexcavated at the end of the infiltration test. Subsurface conditions included silty fine sand to a depth of 10 feet below grade underlain by brown fine to coarse gravel with cobbles from 10 to 16 feet below grade. Groundwater was encountered at a depth of approximately 16 feet below grade.

Infiltration Test IT-3

Infiltration test IT-3 was completed in July 2016, in the channel migration zone on the easternmost portion of the Site (Figure 2). Subsurface conditions at the IT-3 location consist of approximately 2.5 feet of brown silty fine to coarse sand underlain by gray fine to coarse sand with gravel and cobbles. These soils appear to be native soils, no fill was encountered in the infiltration test IT-3 location.

Infiltration test IT-3 was conducted at a depth of approximately 4 feet below grade in the native gray fine to coarse sand with gravel and cobbles. The field infiltration rate measured in IT-3 was 36inches/hour. The infiltration test IT-3 pit was overexcavated at the end of the infiltration test. Subsurface conditions included gray fine to coarse sand with gravel and cobbles to a depth of approximately 16 feet below grade. Groundwater was encountered at a depth of approximately 15 feet below grade.

Infiltration Test IT-4

Infiltration test IT-4 was completed in January 2317, in the channel migration zone on the eastern portion of the Site (Figure 2). Subsurface conditions at the IT-4 location consist of approximately 3.5 feet of fill soils consisting of brown/gray silty fine to coarse sand with wood and bricks. The fill soils are underlain by brown silty fine sand to a depth of approximately 12 feet bgs. The silty fine sand is underlain by brown fine to coarse sand with gravel and cobbles to the depth of the test pit 16 feet bgs.

Infiltration test IT-4 was conducted at a depth of approximately 7 feet below grade in the native brown silty fine sand. The field infiltration rate measured in IT-4 was 3.2 inches/hour. Groundwater was encountered at a depth of approximately 15 feet below grade.

Test Pit TP-14

Test pit TP-14 was completed in the proposed stormwater infiltration pond area to further assess subsurface soil and groundwater conditions and collect a soil sample from the potential infiltration receptor material for analysis of CEC and organic content.

2.2 LABORATORY TESTING

Soil samples of the silty sand infiltration receptor soils were collected from infiltration test pit IT-4 and test pit TP-14, located within the footprint of the potential infiltration pond area. The soil samples were submitted to Friedman and Bruya laboratory for analysis of cation exchange capacity and organic content. Grain size analyses were also completed on these two potential infiltration receptor soils. The results and descriptions of the laboratory tests are enclosed in Appendix A.

Cation Exchange Capacity/Organic Content

Infiltration receptor soils may be deemed adequate for water quality treatment if the cation exchange capacity (CEC) is equal to or greater than 5 milliequivalents CEC/100g dry soil and the organic content is one-percent or greater.

The laboratory reported CEC value for soil sample IT-4 is 11 meq/100g which is above the required 5 milliequivalents required to be considered a treatment soil. The CEC value for soil sample TP-14 is 12 meq/100g which is also above the required 5 milliequivalents required to be considered a treatment soil. The organic content for soil samples IT-4 and TP-14 is 3.9 percent. Both organic content results are above the required 0.5 percent required for treatment.

Soil samples of the stormwater receptor soils collected within the potential infiltration pond footprint meet the CEC and organic content levels for a treatment soil.

3.0 Design Infiltration Rate

Correction factors in the Volume III Chapter 3 of the 2014 Ecology manual were used to evaluate a long-term design infiltration rate from the field measured rates using the modified PIT methodology. The correction factors are applied to the measured field infiltration rates to yield a long-term design infiltration rate. Correction factors applied to the field infiltration rate include 1) Site variability and number of locations tested; 2) Test method; and 3) Degree of influent control to prevent siltation and bio-buildup.

$CF_T = CF_v \times CF_t \times CF_m$

Where:

CF_T = Total correction factor

CF_v = Site variability and number of locations tested

CF_t = Test method (Large-scale PIT, Small-scale PIT, Other small-scale, Grain size method)

CF_m = Degree of influent control to prevent siltation and bio-buildup

CF_v Site Variability and Number of Locations Tested

The number of locations tested in the proposed infiltration area must be capable of producing a picture of the subsurface conditions that fully represents the conditions throughout the area propose for infiltration. The value for this correction factor ranges from 0.33 to 1.0. The lower end of the range for this correction factor would be indicative of high variable subsurface conditions due to the geologic setting and a limited number of infiltration test. The higher end of this correction factor would be indicative of more uniform subsurface conditions and a higher number of infiltration tests in the proposed infiltration area. A value of 0.75 was assigned to the correction factor for site variability and tested locations. Four test pit were completed in the infiltration area IT-2, IT-4, TP-11, TP-14

CF_t Test Method

The correction factor for the test methods are dictated in the design manual

Test Method	*Correction Factor*
Large-scale PIT	0.75
Small-scale PIT	0.50
Other small-scale (e.g. double ring, falling head)	0.40

Grain size method 0.40

CF_m Degree of influent control to prevent siltation and bio-buildup

Based on a manual prescribed maintenance schedule that calls for removing sediment when the facility is infiltrating at only 90% of its design capacity, a CF_m correction factor of 0.90 is required.

Site Correction Factor

CF_T = 0.75 x 0.75 x 0.9 = 0.50 (applied to the field infiltration rate).

Long-Term Design Infiltration Rates

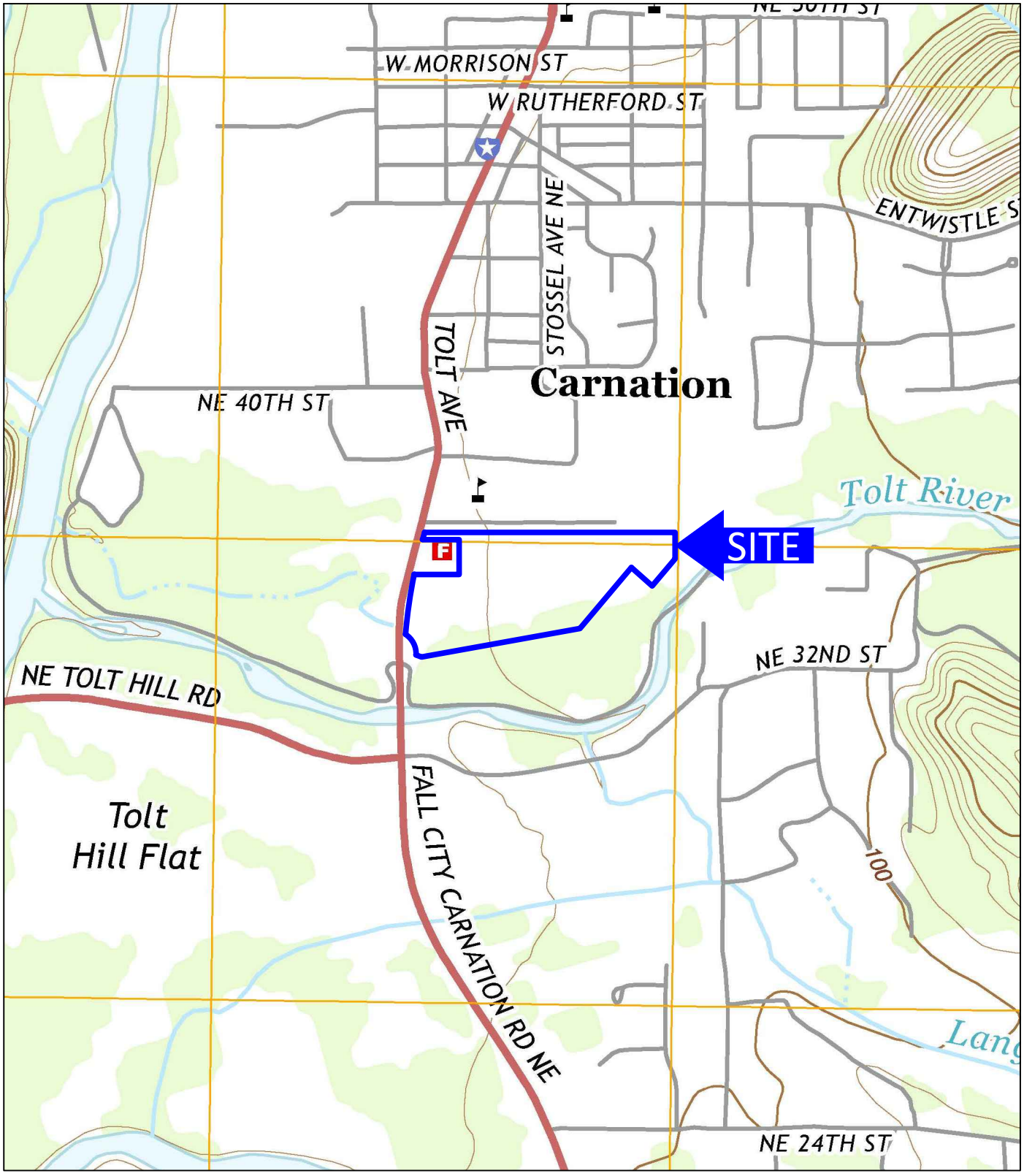
Field rates for the two PIT infiltration tests completed within the area of the proposed stormwater infiltration facility (IT-2 and IT-4) were 8 inches/hour (IT-2) and 3.2 inches/hour (IT-4). The average field measured infiltration rate for IT-2 and IT-4 is 5.6 inches/hour. The correction factor derived above was applied to the average of the rates measured in IT-2 and IT-4 to yield a long-term design infiltration rate of 2.8 inches/hour.

4.0 Limitations

This report is the property of RGI, MainVue Homes, and its designated agents. Within the limits of the scope and budget, this report was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this report was issued. This report is intended for specific application to MainVue Homes Carnation, Washington property. No other warranty, expressed or implied, is made.

The scope of services for this project does not include either specifically or by implication any environmental or biological (for example, mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, we can provide a proposal for these services.

The analyses and recommendations presented in this report are based upon data obtained from the test exploration performed on site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, RGI should be requested to reevaluate the recommendations in this report prior to proceeding with construction.



USGS, 2014, Carnation, Washington
7.5-Minute Quadrangle

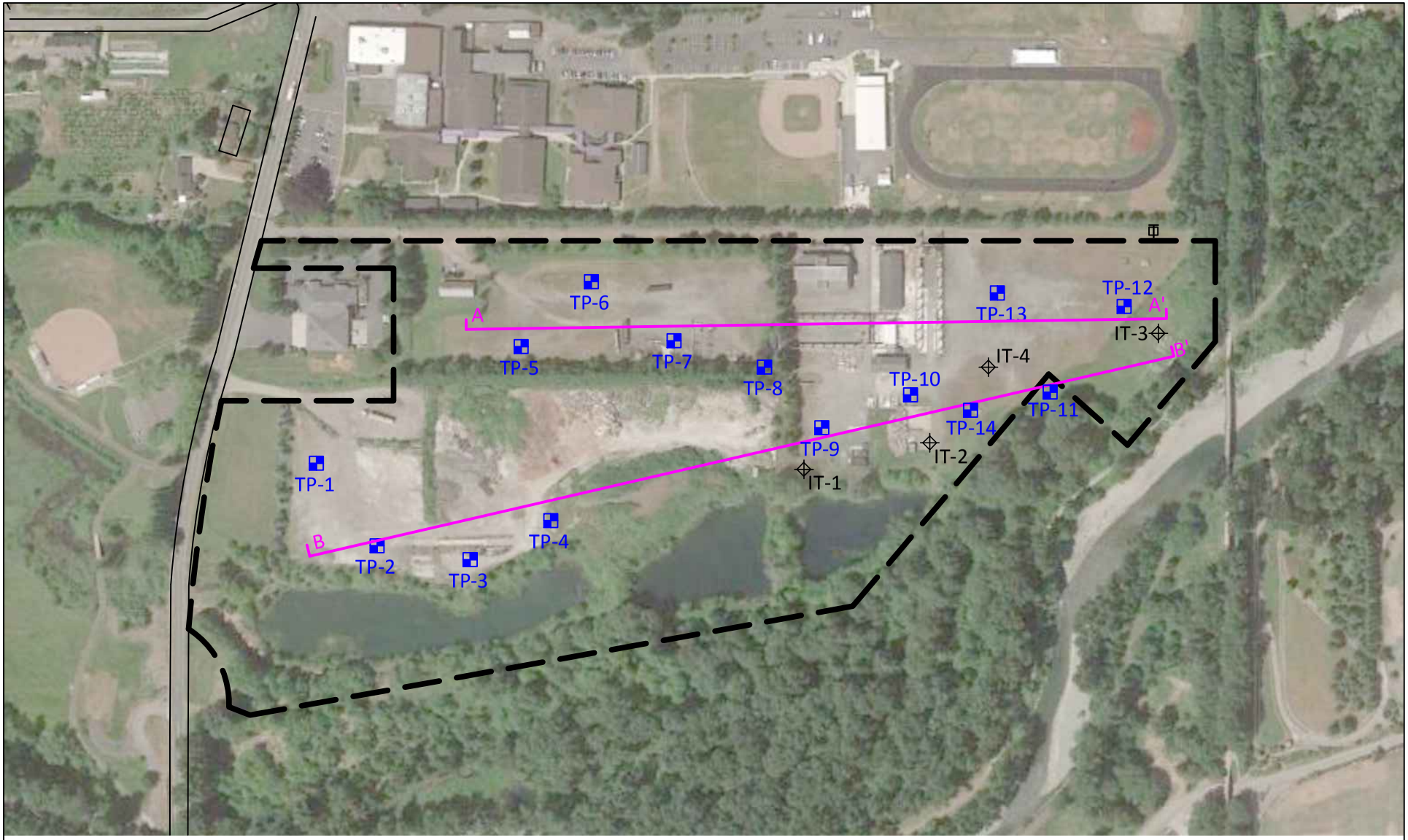
Approximate Scale: 1"=1000'

0 500 1000 2000

N

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

MainVue Homes Carnation Property		Figure 1
RGI Project Number 2016-115	Site Vicinity Map	Date Drawn: 01/2017
Address: 3440 Tolt Avenue, Carnation, Washington 98014		



= Infiltration test location, July 2016 and January 2017

= Test pit location, 2015 and 2017

= Site boundary

Approximate Scale: 1"=300'

0 150 300 600

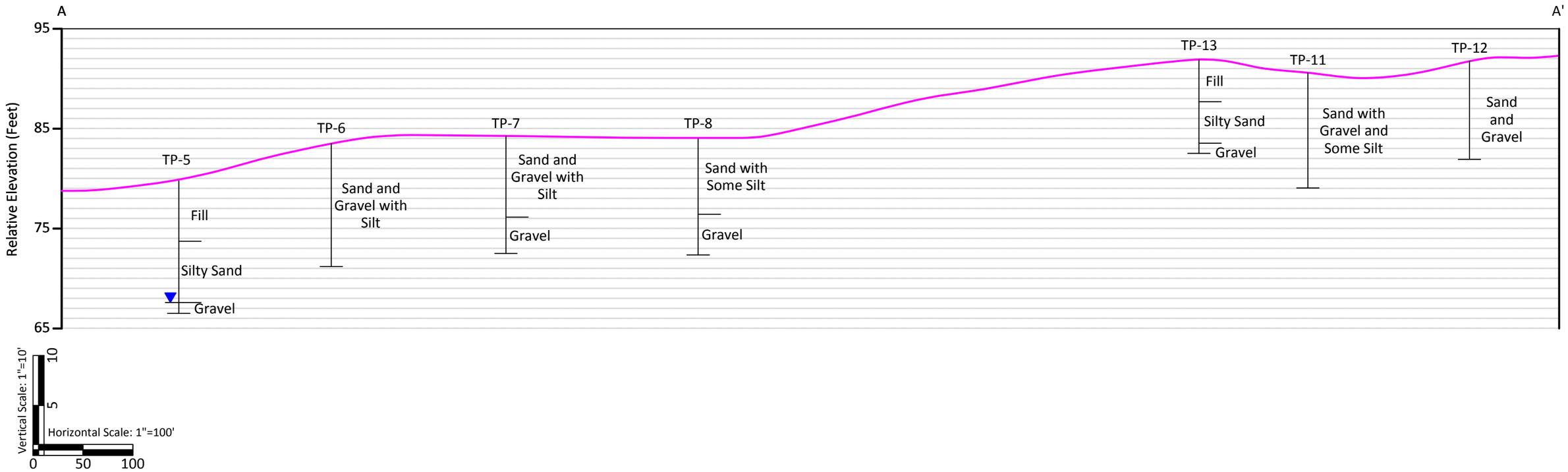
N

RILEYGROUP

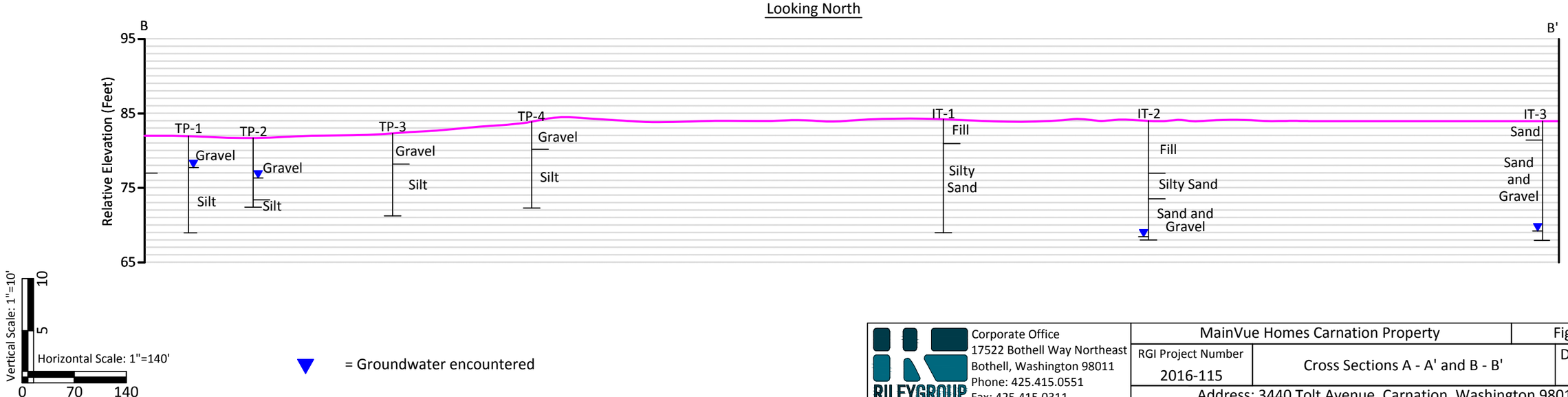
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

MainVue Homes Carnation Property		Figure 2
RGI Project Number 2016-115	Geotechnical Exploration Plan	Date Drawn: 01/2017
Address: 3440 Tolt Avenue, Carnation, Washington 98014		

Looking North



Looking North



▼ = Groundwater encountered

RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

MainVue Homes Carnation Property		Figure 3
RGI Project Number 2016-115	Cross Sections A - A' and B - B'	Date Drawn: 01/2017
Address: 3440 Tolt Avenue, Carnation, Washington 98014		

APPENDIX A
FIELD EXPLORATION LOGS AND LABORATORY TESTING

Grain Size Analysis

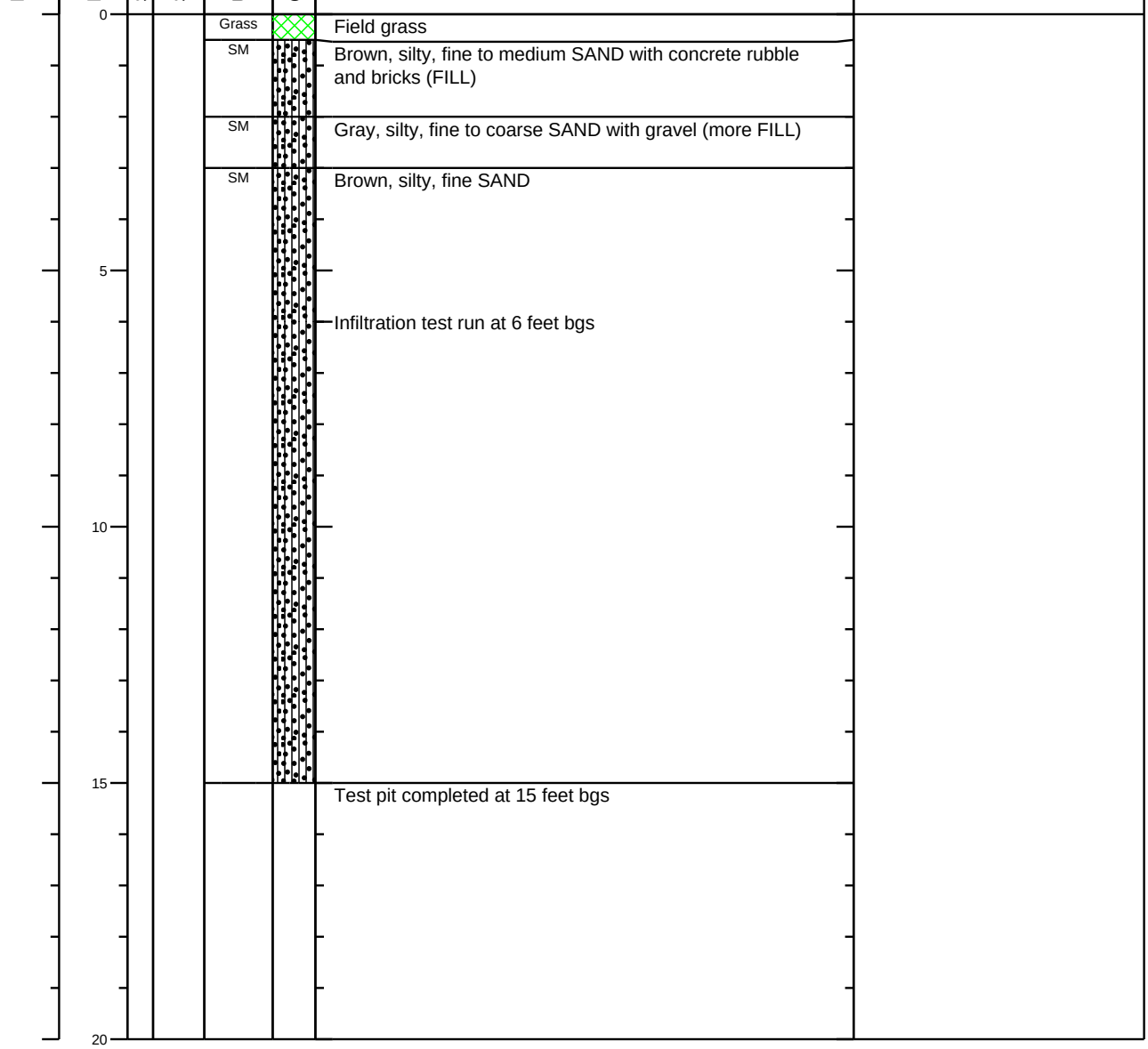
A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses was determined using D6913-04(2009) Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM D6913).

Analytical Result

Soil samples were submitted to Friedman & Bruya, Inc. analytical laboratories for analysis of Cation Exchange Capacity and Organic Content.

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue WA LLC**	RILEYGROUP Test Pit No.: IT-1 **Sheet 1 of 1**

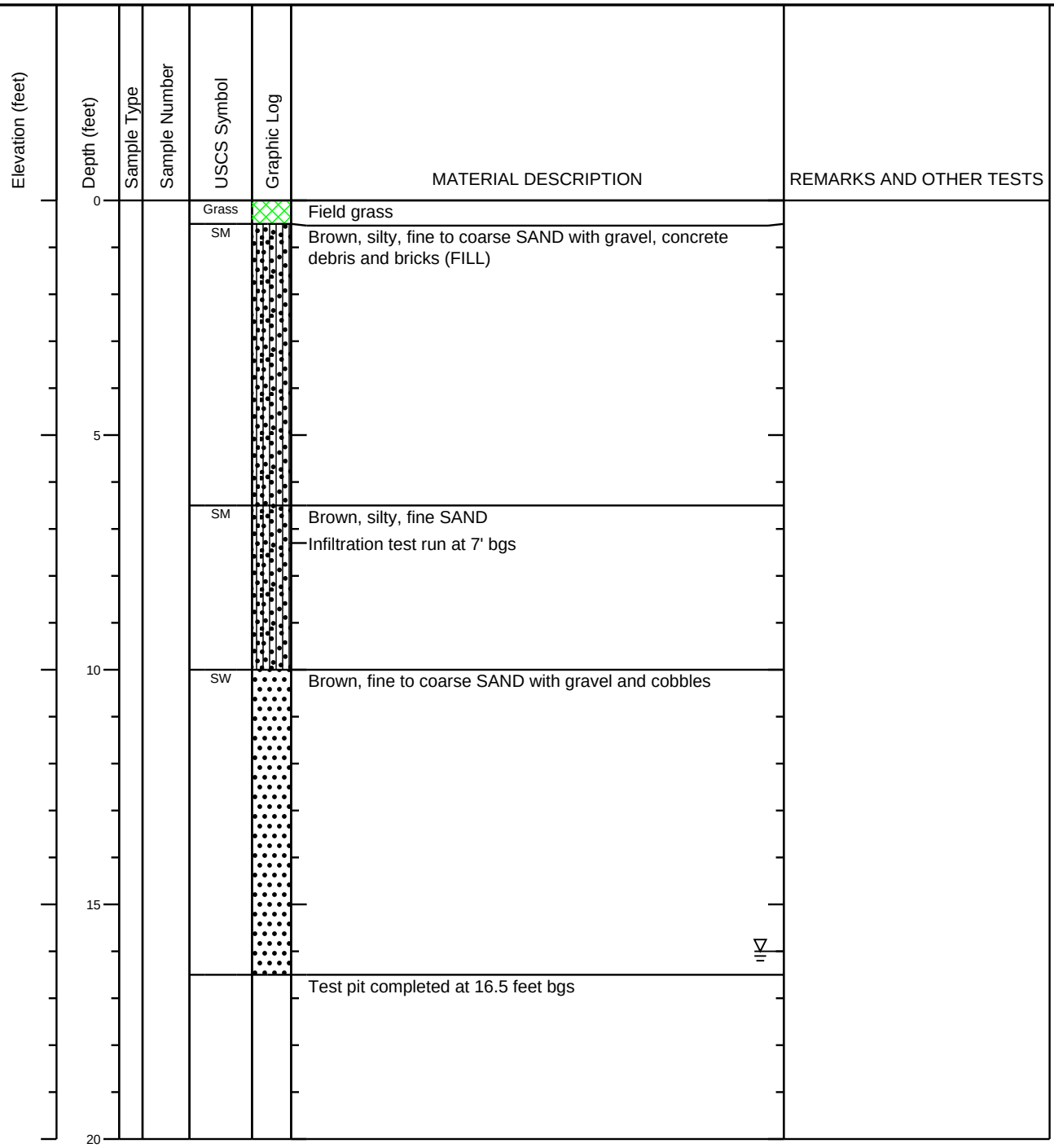
Date(s) Excavated: **07/11/16**	Logged By **DB**	Surface Conditions: **Field Grass**
Excavation Method: **Trackhoe**	Bucket Size: **3.5 Feet**	Total Depth of Excavation: **15 feet bgs**
Excavator Type: **Track-Mounted**	Excavating Contractor: **RGI**	Approximate Surface Elevation **n/a**
Groundwater Level: **Not Encountered**	Sampling Method(s) **n/a**	Compaction Method **Bucket Tamp**
Test Pit Backfill: **Native Soils**	Location **3440 Tolt Avenue, Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue WA LLC**	RILEYGROUP Test Pit No.: IT-2 **Sheet 1 of 1**

Date(s) Excavated: **07/12/16**	Logged By **DB**	Surface Conditions: **Field Grass**
Excavation Method: **Trackhoe**	Bucket Size: **3.5 Feet**	Total Depth of Excavation: **16.5 feet bgs**
Excavator Type: **Track-Mounted**	Excavating Contractor: **RGI**	Approximate Surface Elevation **n/a**
Groundwater Level: **16'**	Sampling Method(s) **n/a**	Compaction Method **Bucket Tamp**
Test Pit Backfill: **Native Soils**	Location **3440 Tolt Avenue, Carnation, Washington 98014**	



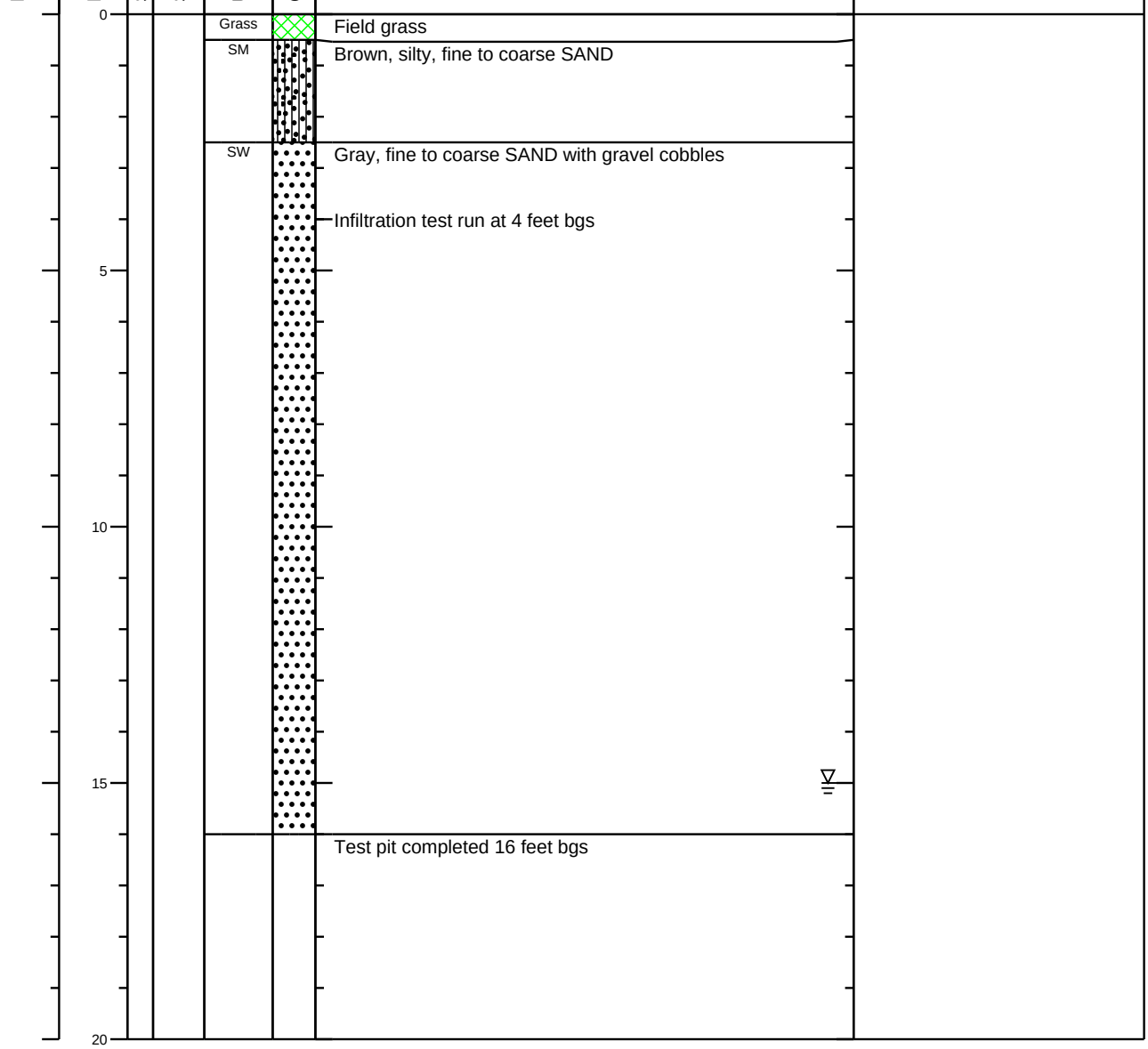
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue WA LLC**

RILEYGROUP

Test Pit No.: IT-3

Sheet 1 of 1

Date(s) Excavated: **07/13/16**	Logged By **DB**	Surface Conditions: **Field Grass**
Excavation Method: **Trackhoe**	Bucket Size: **3.5 Feet**	Total Depth of Excavation: **16 feet bgs**
Excavator Type: **Track-Mounted**	Excavating Contractor: **RGI**	Approximate Surface Elevation **n/a**
Groundwater Level: **15'**	Sampling Method(s) **n/a**	Compaction Method **Bucket Tamp**
Test Pit Backfill: **Native Soils**	Location **3440 Tolt Avenue, Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

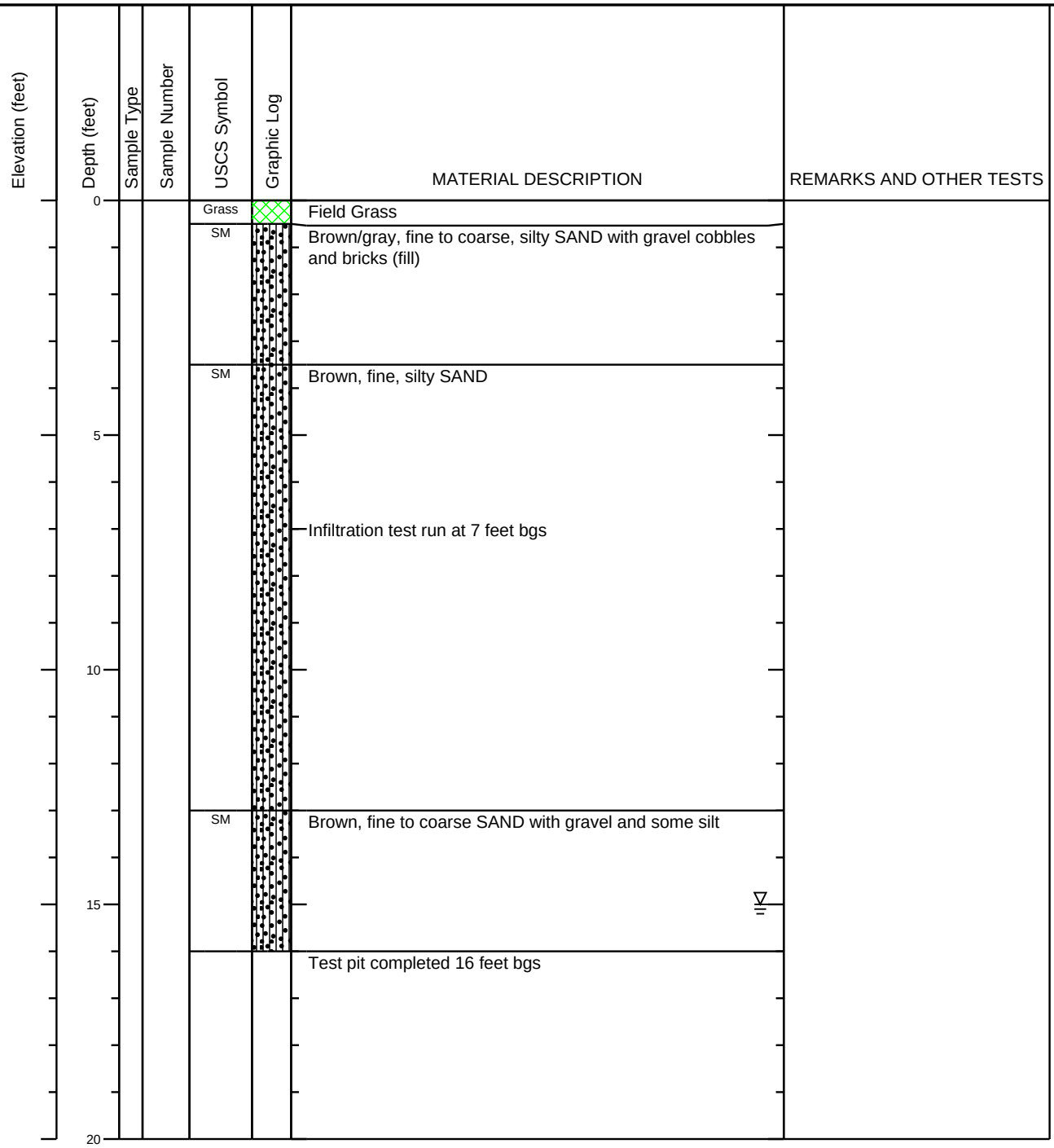
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue WA LLC**

RILEYGROUP

Test Pit No.: IT-4

Sheet 1 of 1

Date(s) Excavated: **01/12/17**	Logged By **DB**	Surface Conditions: **Field Grass**
Excavation Method: **Trackhoe**	Bucket Size: **3.5 Feet**	Total Depth of Excavation: **16 feet bgs**
Excavator Type: **Track-Mounted**	Excavating Contractor: **RGI**	Approximate Surface Elevation **n/a**
Groundwater Level: **15'**	Sampling Method(s) **n/a**	Compaction Method **Bucket Tamp**
Test Pit Backfill: **Native Soils**	Location **3440 Tolt Avenue, Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue WA LLC**

RILEYGROUP

Key to Logs

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample Number: Sample identification number.
5. USCS Symbol: USCS symbol of the subsurface material.
6. Graphic Log: Graphic depiction of the subsurface material encountered.
7. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
8. REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Grass and/or topsoil
Silty SAND (SM)
Well graded SAND (SW)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Continuous
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

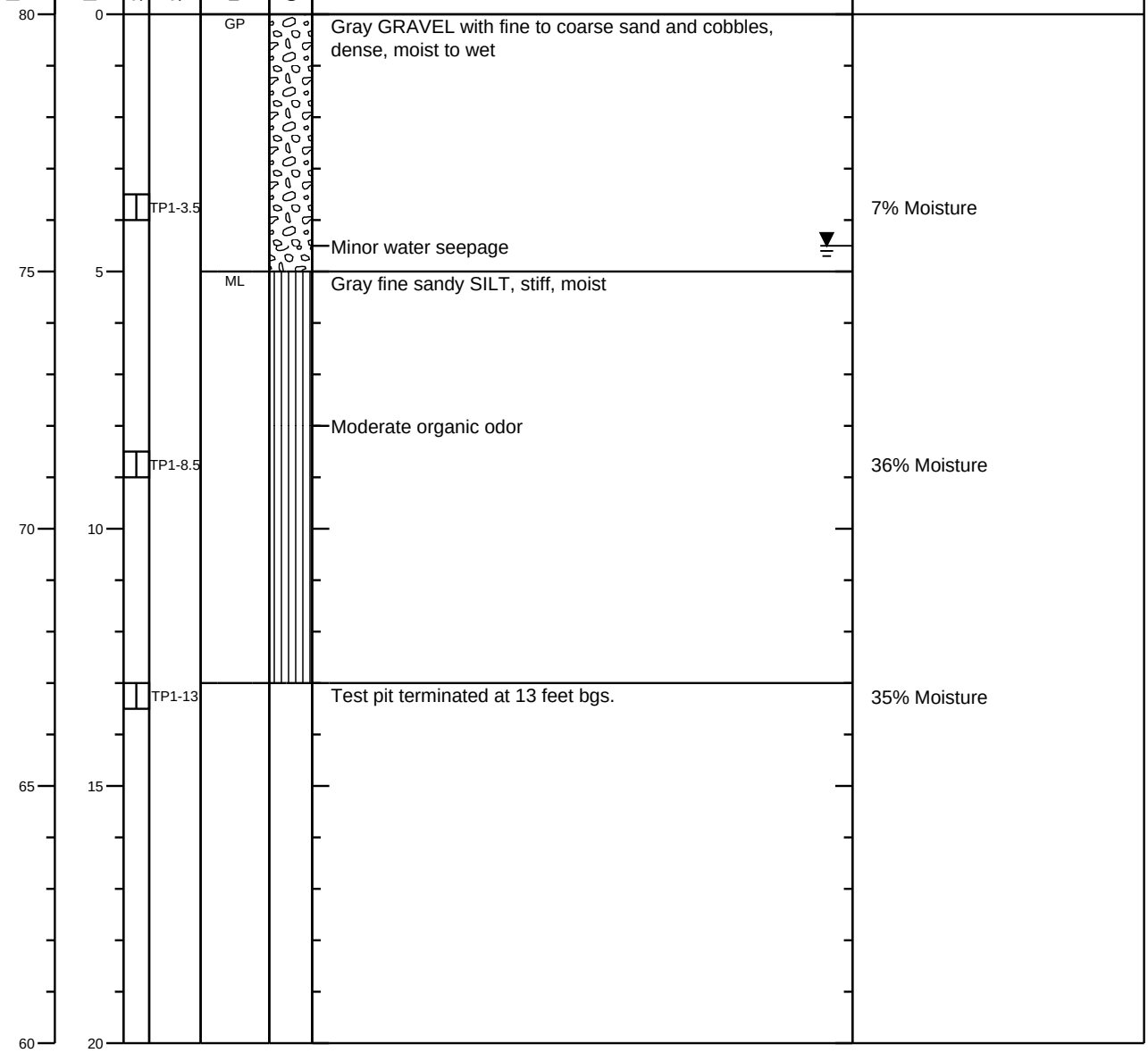
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-1

Sheet 1 of 1

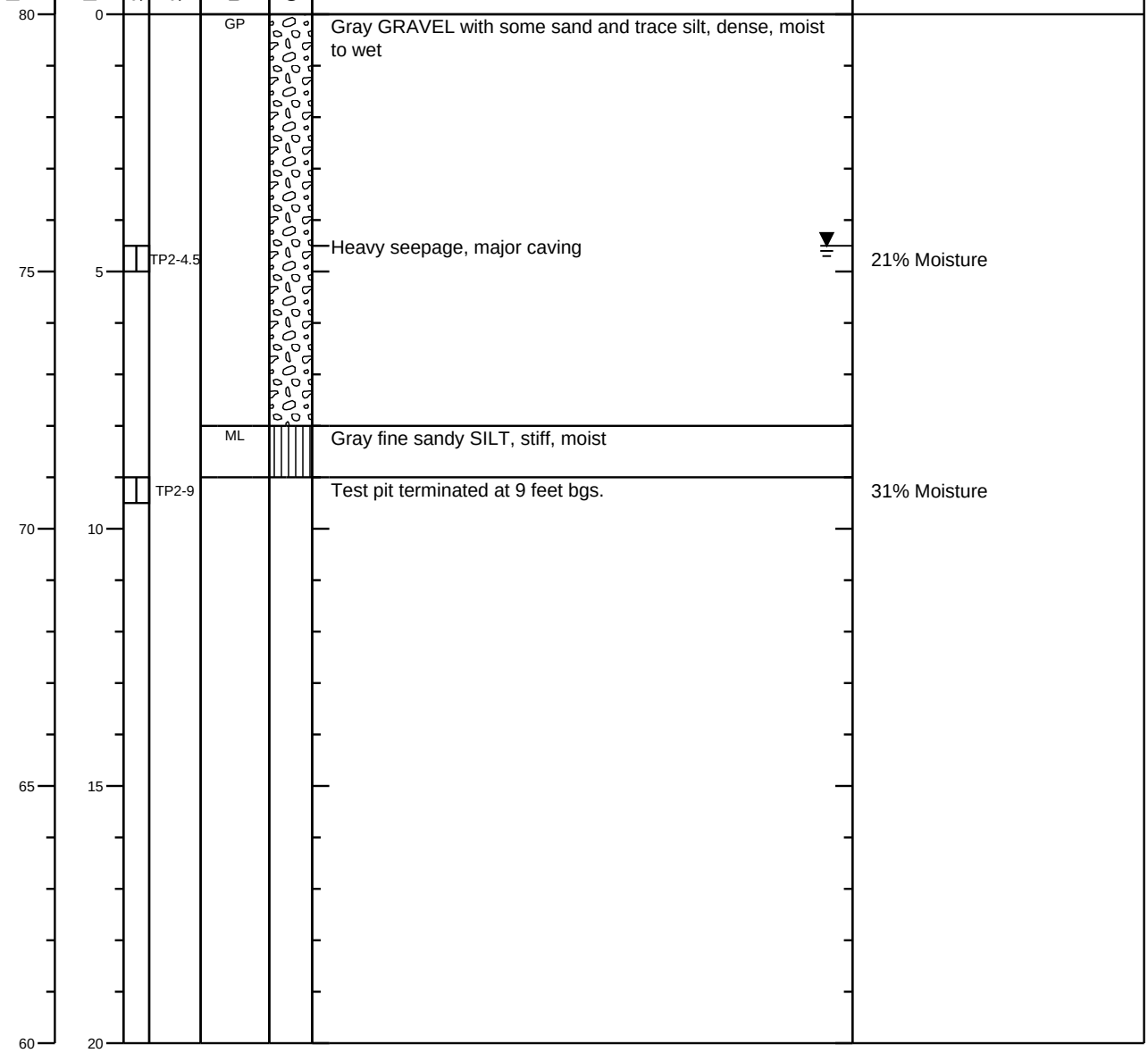
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **13'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **80'**
Groundwater Level: **4.5'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-2 **Sheet 1 of 1**

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **9'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **80'**
Groundwater Level: **4.5'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



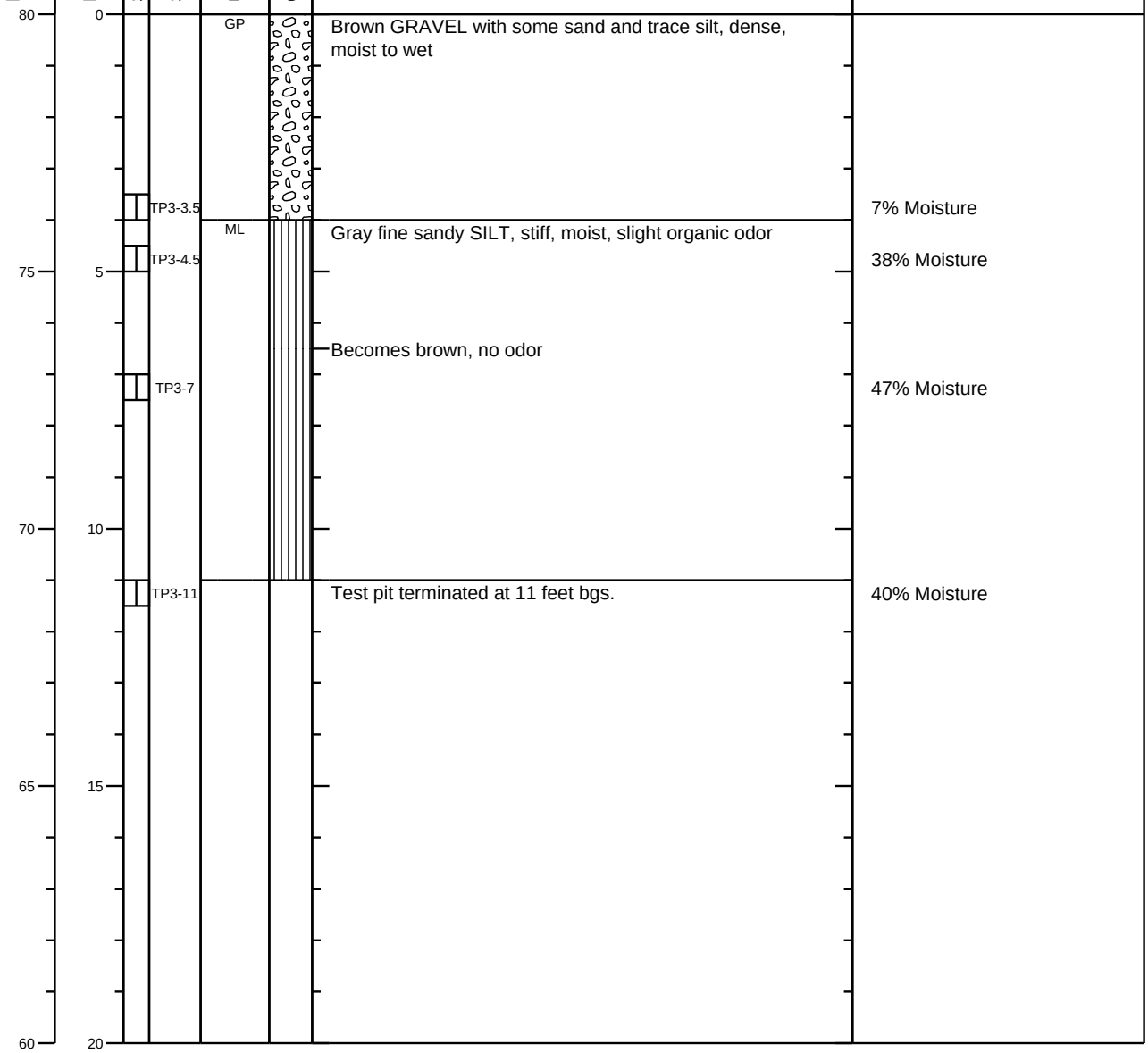
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-3

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **80'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

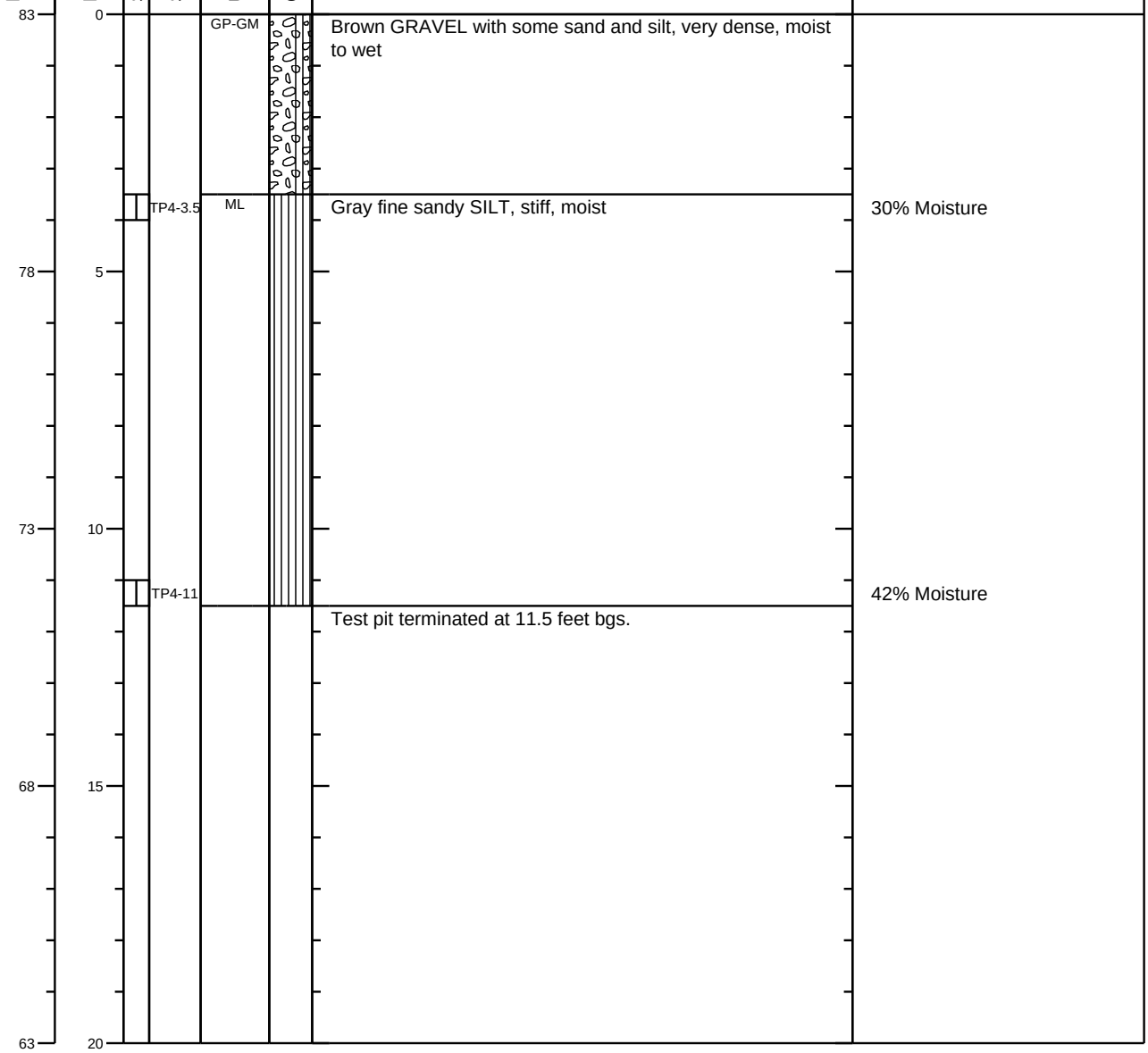
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-4

Sheet 1 of 1

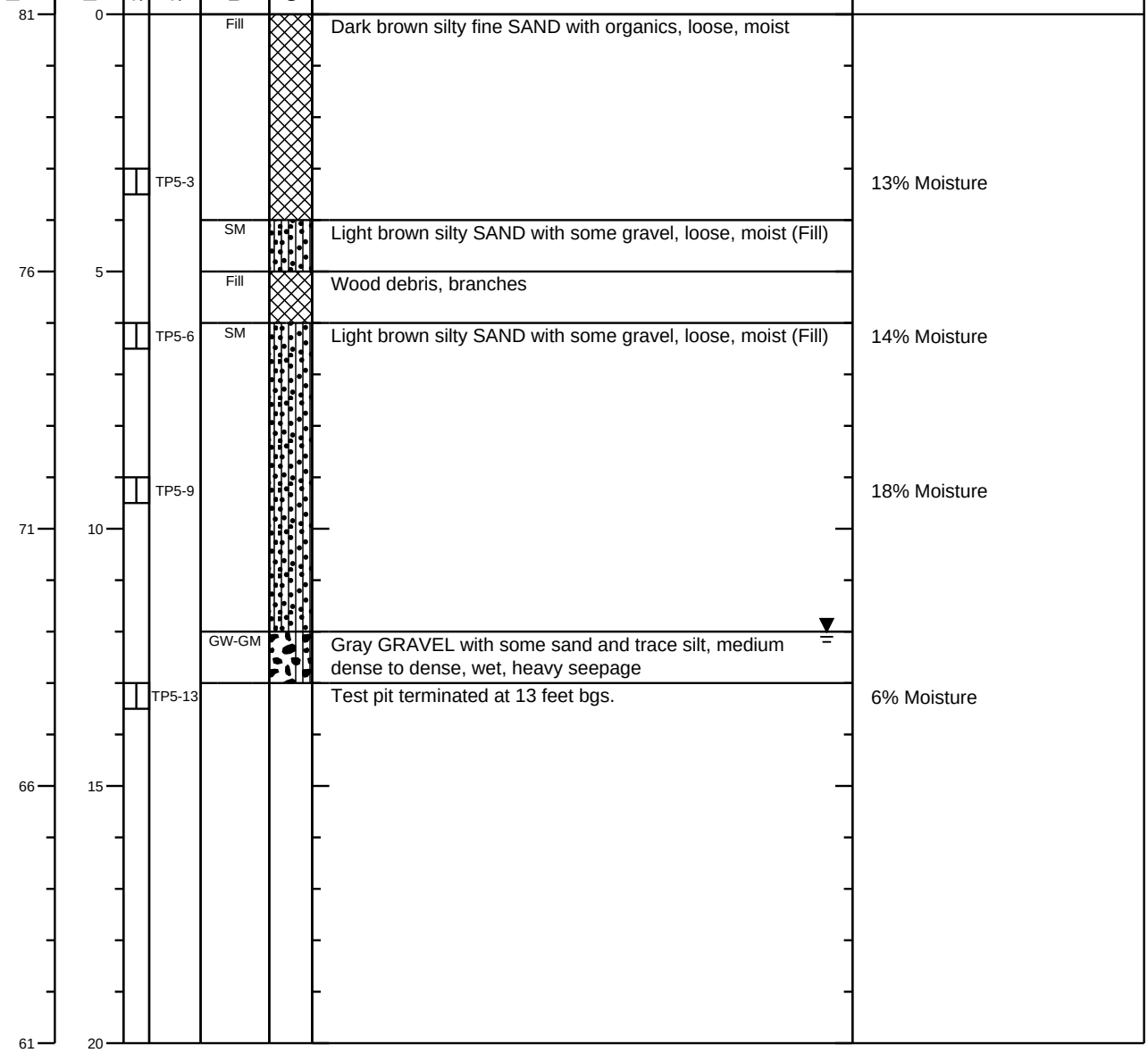
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **83'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-5 **Sheet 1 of 1**

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **13'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **81'**
Groundwater Level: **12'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

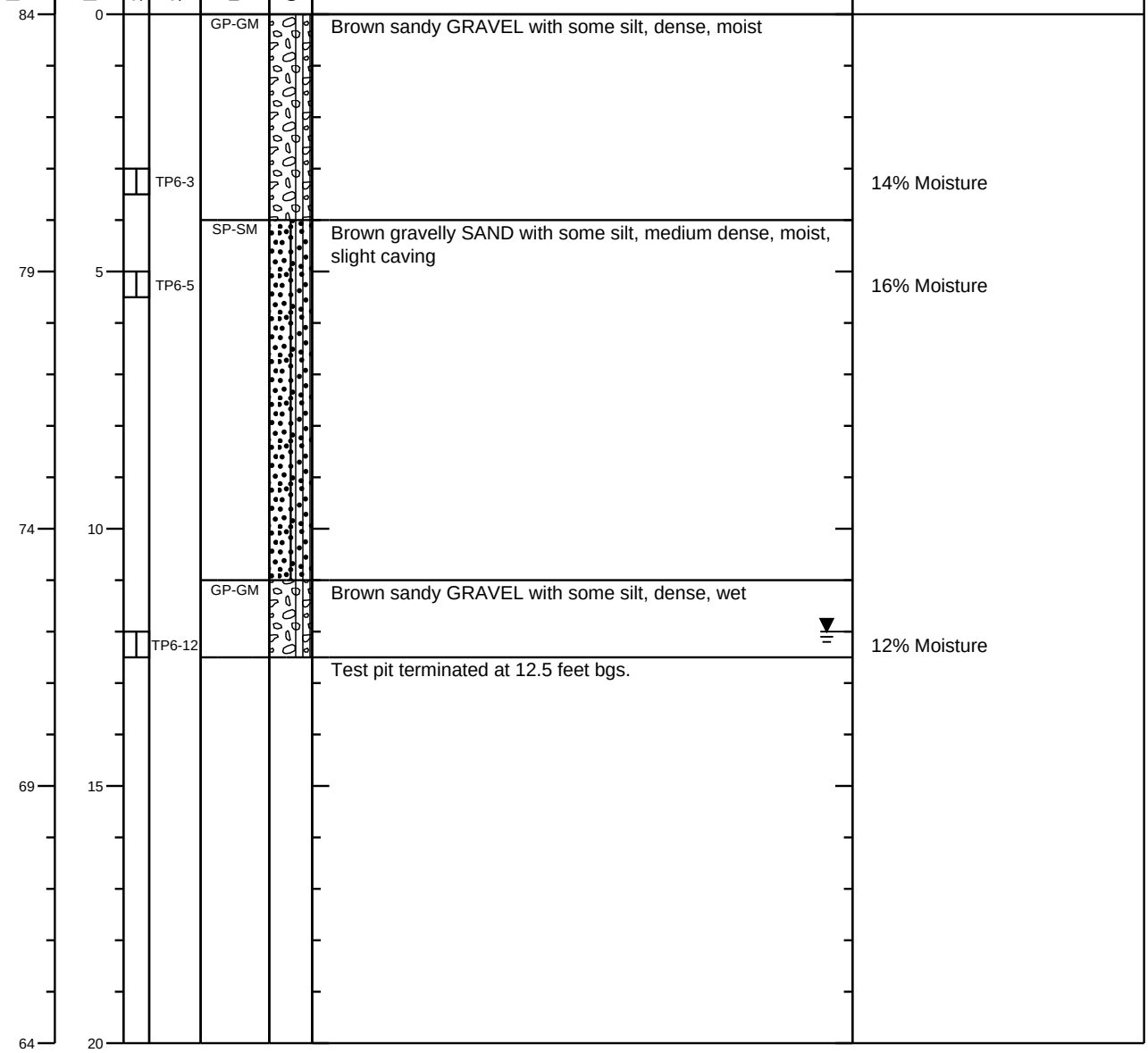
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-6

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Gravel**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **12.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **84'**
Groundwater Level: **12'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

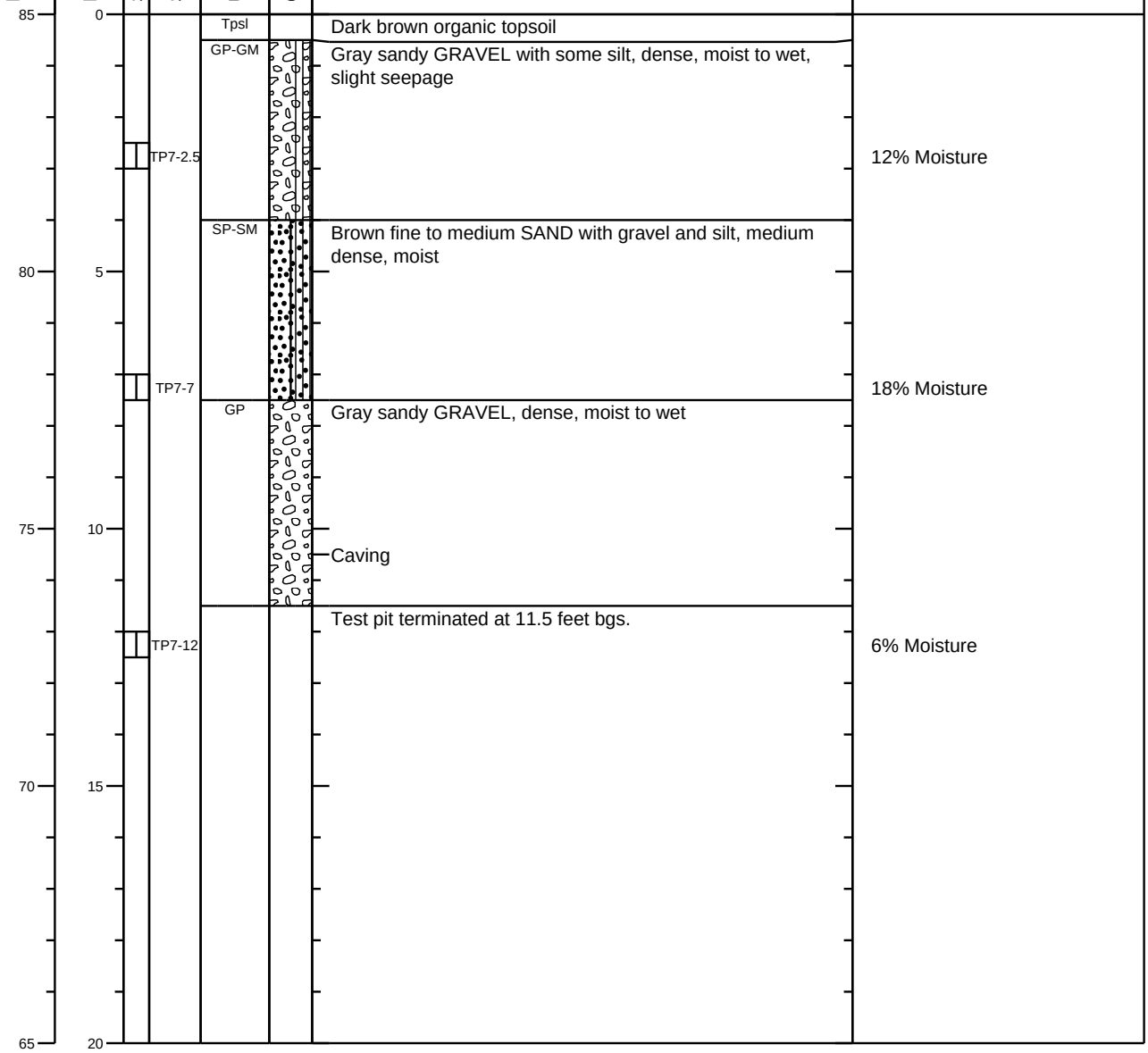
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-7

Sheet 1 of 1

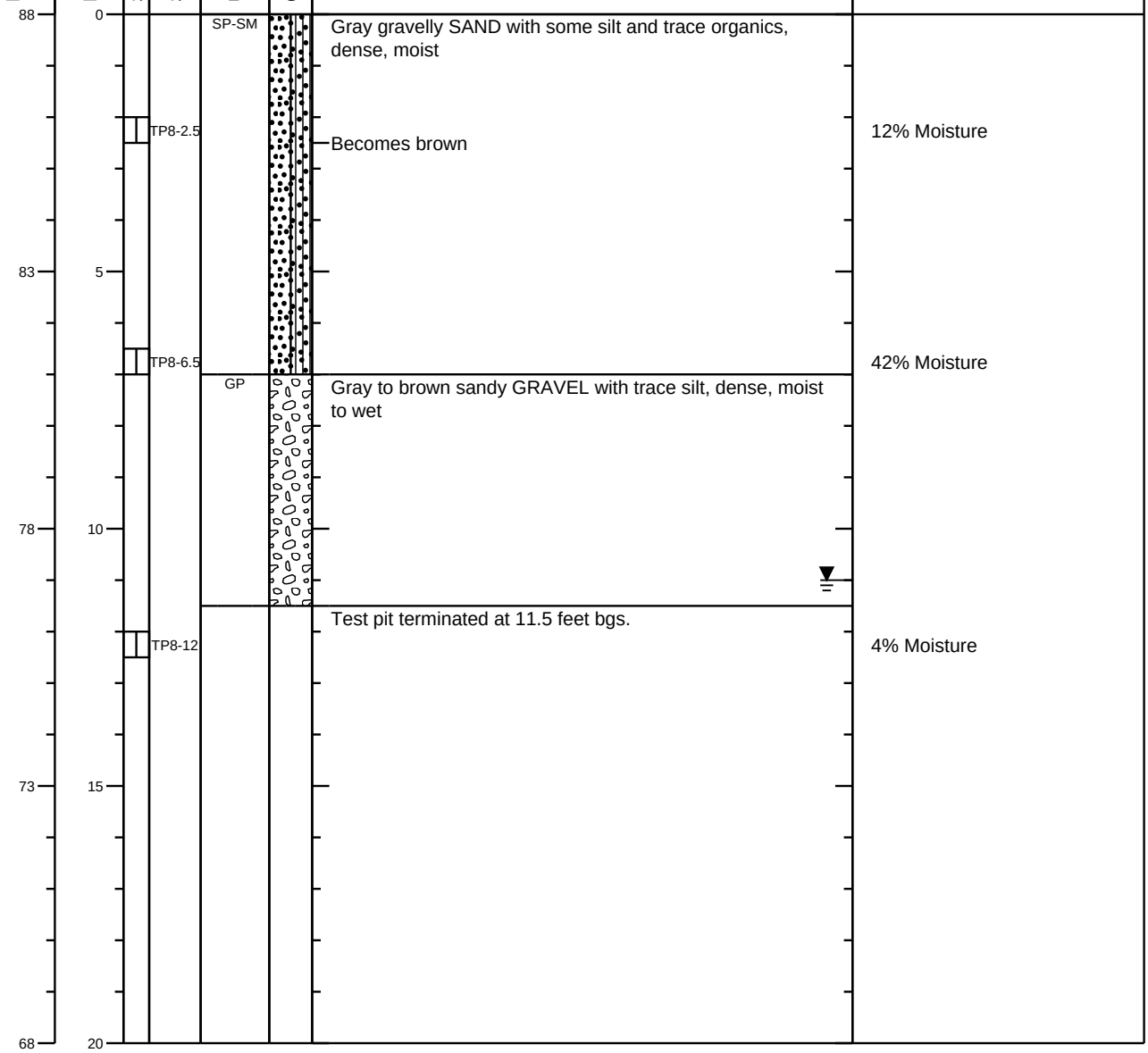
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **85'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-8 **Sheet 1 of 1**

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **88'**
Groundwater Level: **11'**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

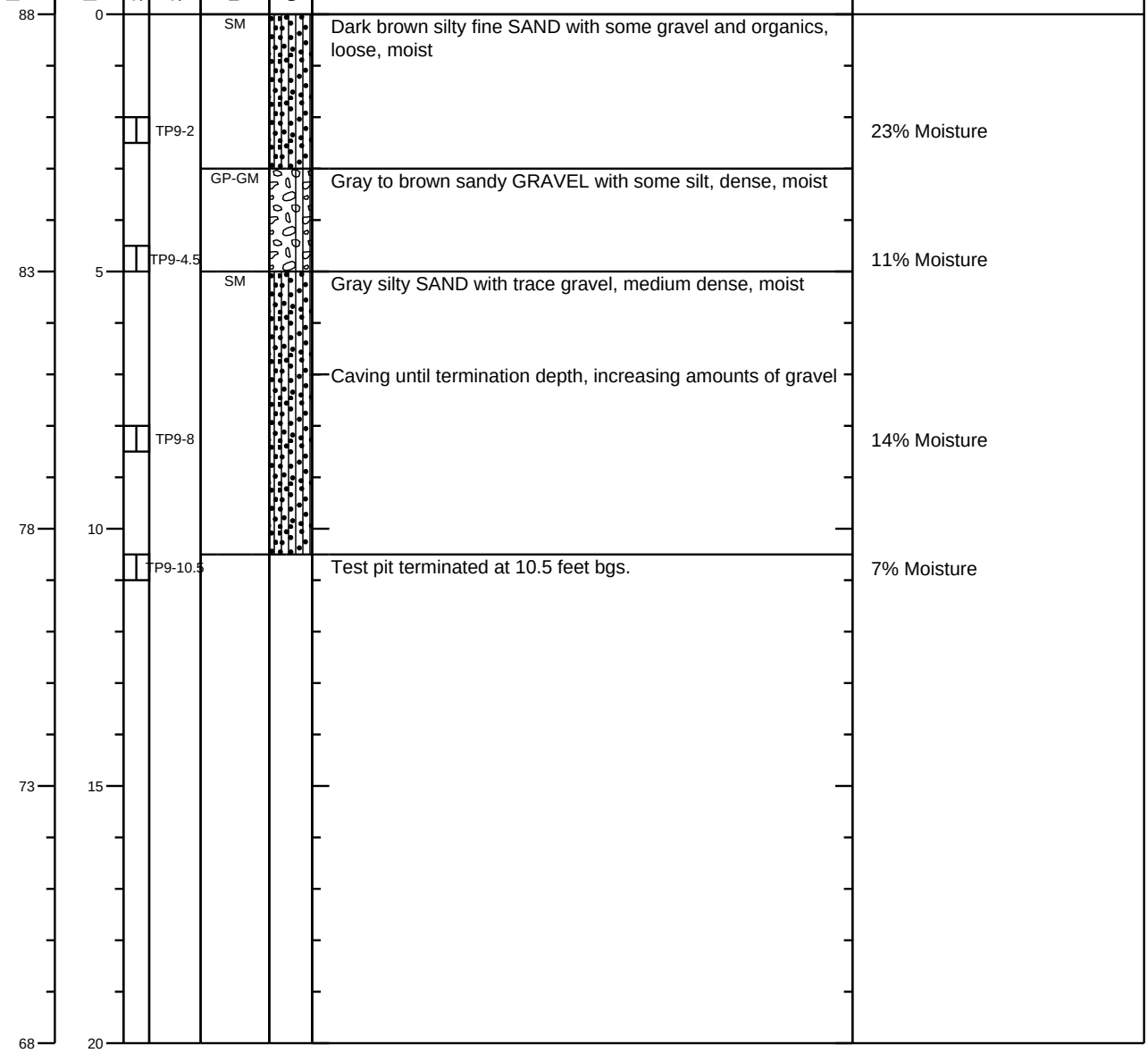
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-9

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **10.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **88'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

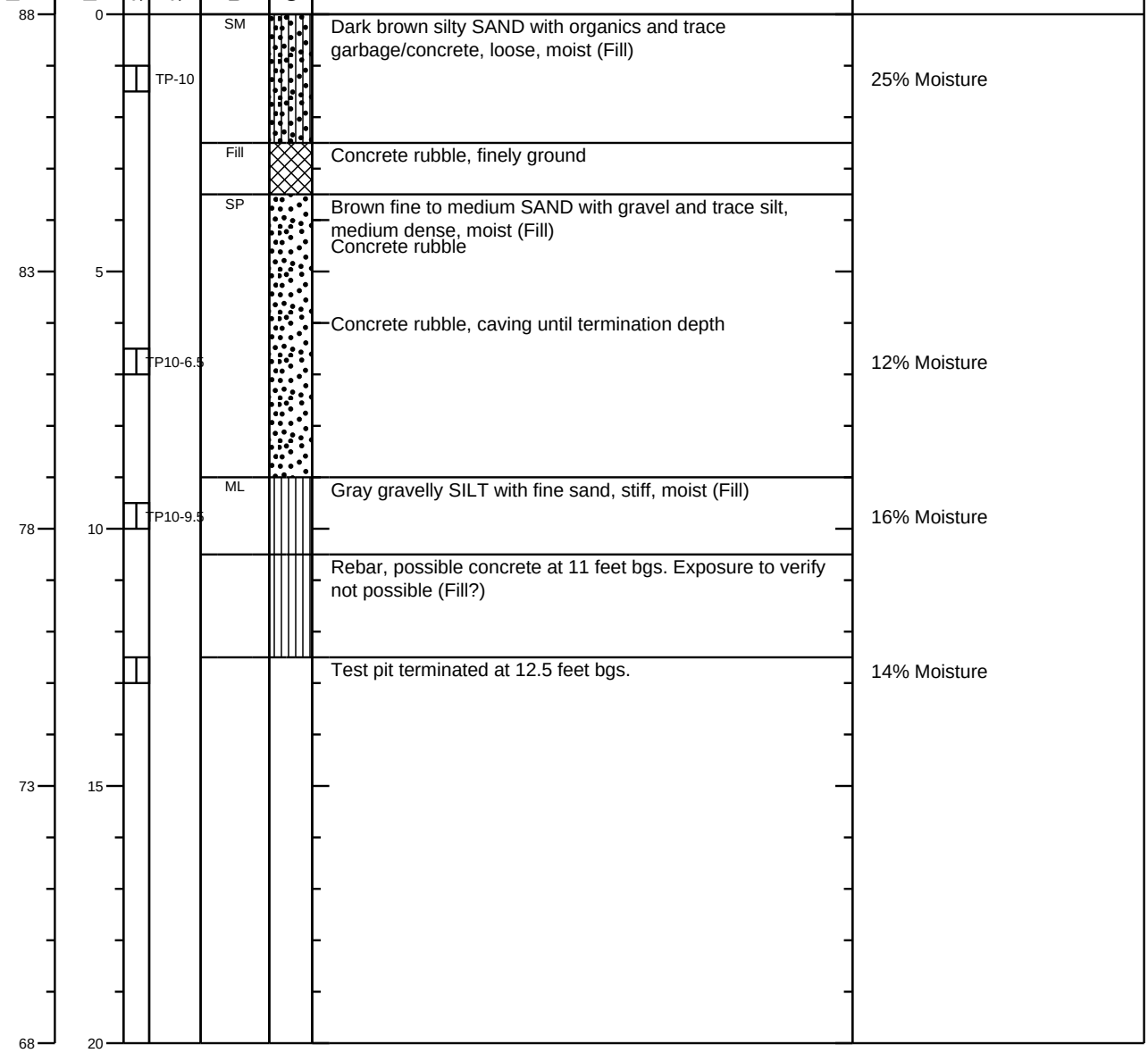
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-10

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **12.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **88'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

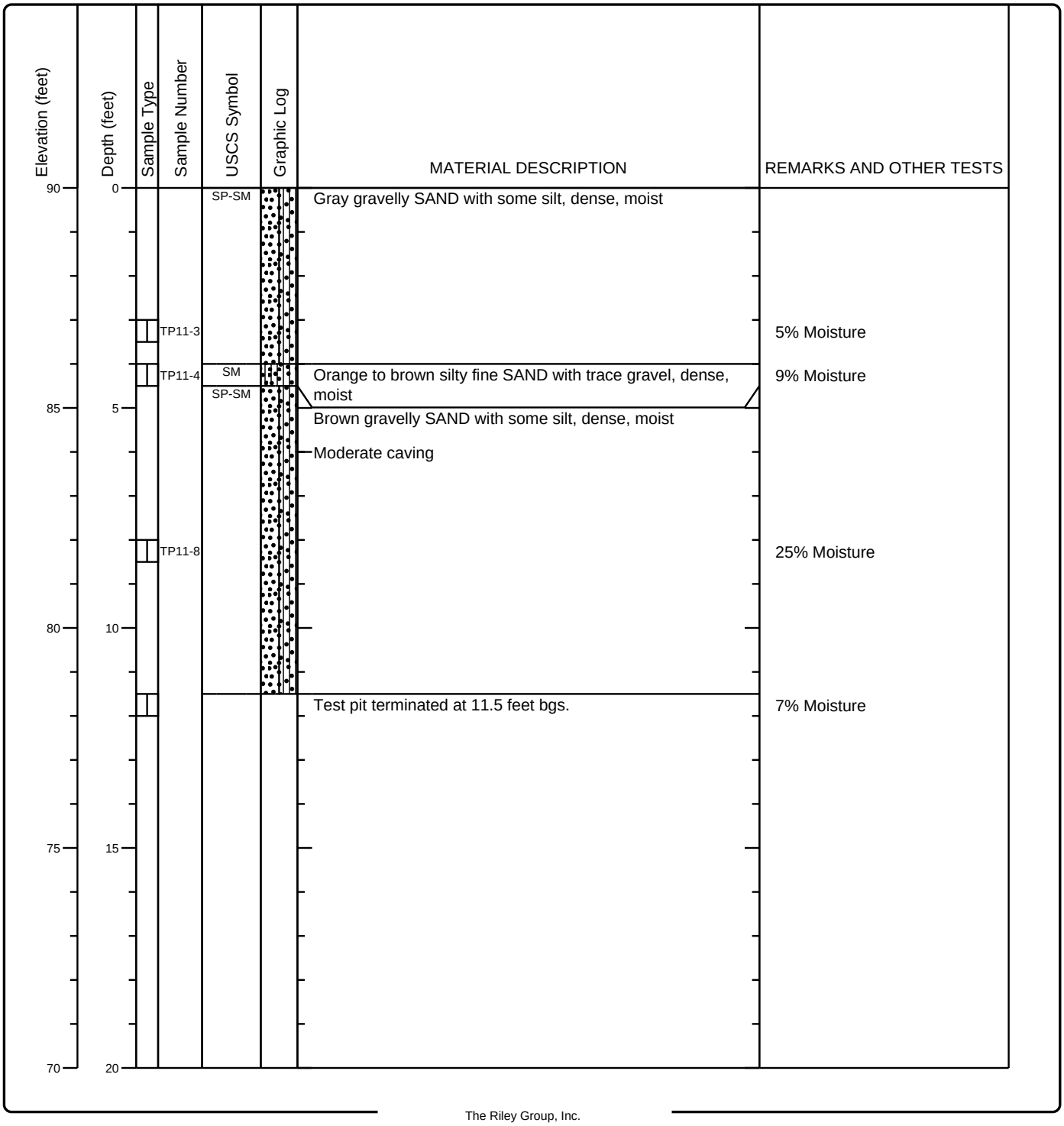
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-11

Sheet 1 of 1

Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **11.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **90'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

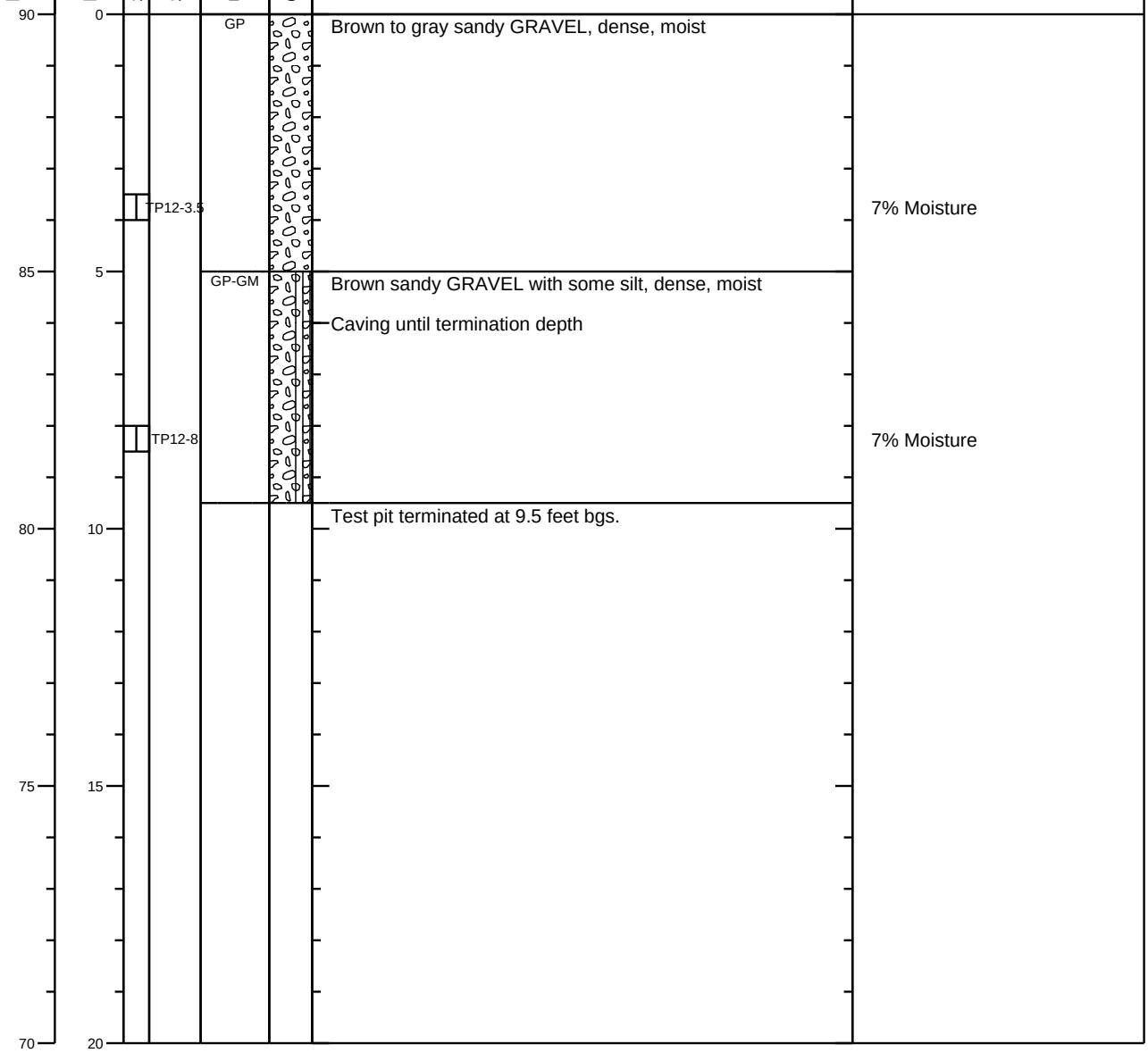
Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Test Pit No.: TP-12

Sheet 1 of 1

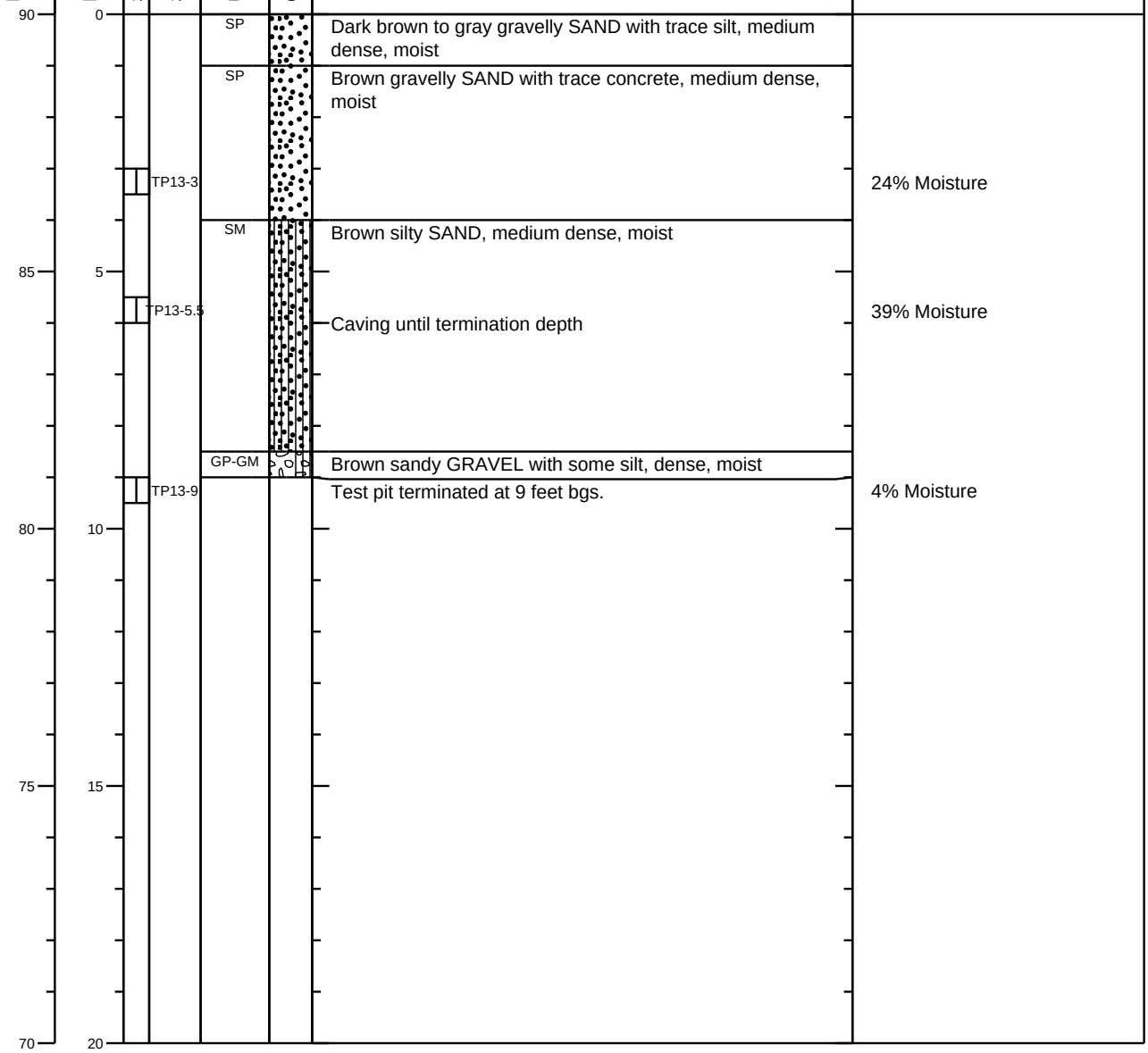
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **9.5'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **90'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-13 **Sheet 1 of 1**

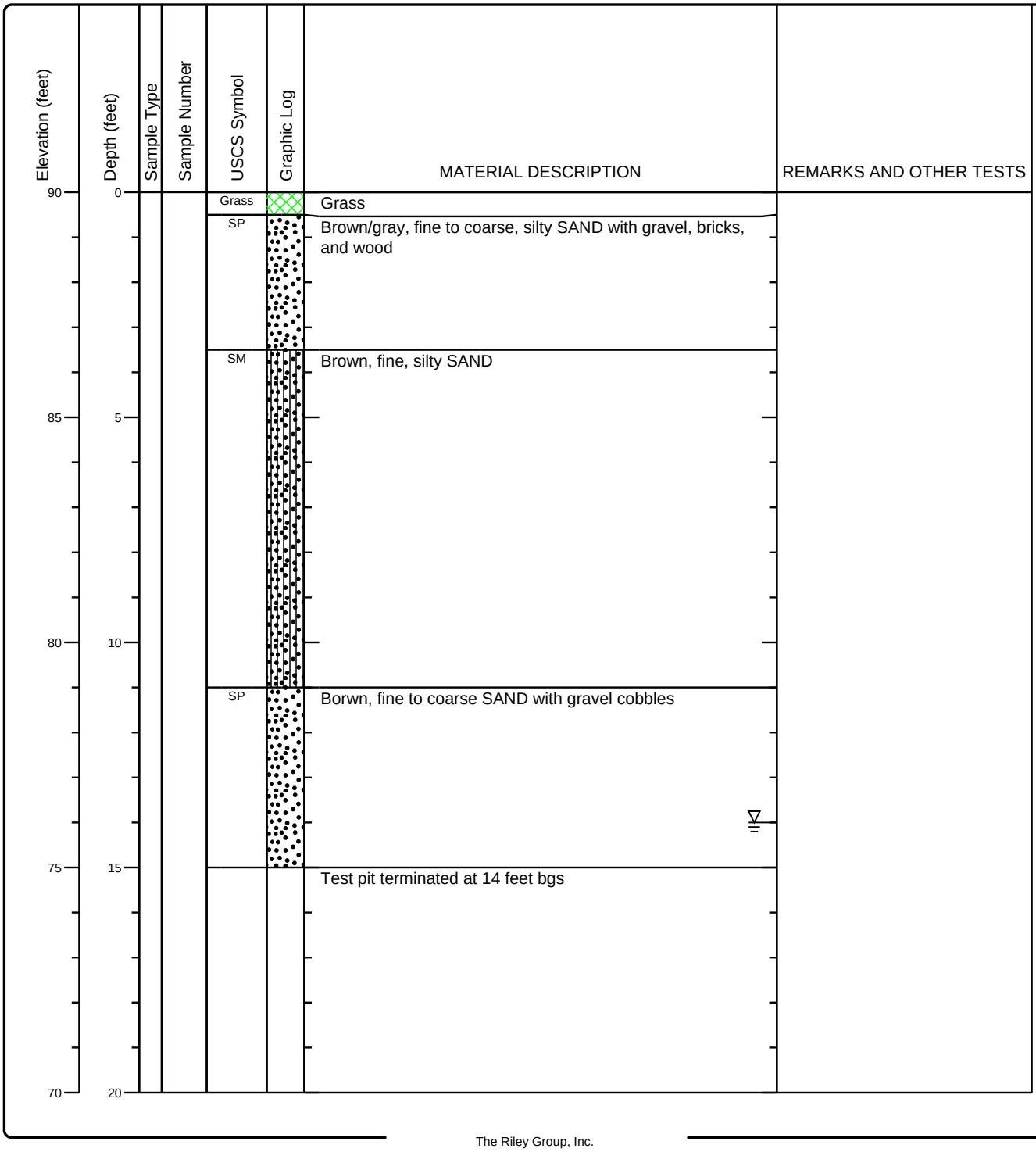
Date(s) Excavated: **12/17/2015**	Logged By **AJ**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **9'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **90'**
Groundwater Level: **Not encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **MainVue Homes Carnation Property** Project Number: **2016-115** Client: **MainVue Homes**	RILEYGROUP Test Pit No.: TP-14 **Sheet 1 of 1**

Date(s) Excavated: **12/17/2015**	Logged By **DJB**	Surface Conditions: **Grass**
Excavation Method: **Track hoe**	Bucket Size: **2'**	Total Depth of Excavation: **15'**
Excavator Type: **Track-mounted**	Excavating Contractor:	Approximate Surface Elevation **90'**
Groundwater Level: **14'**	Sampling Method(s)	Compaction Method **Bucket tamp**
Test Pit Backfill: **Cuttings**	Location **3440, 3660, and 3700 Tolt Avenue Carnation, Washington 98014**	



THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mainvue Homes Carnation Property		**SAMPLE ID/TYPE**	IT-1	
PROJECT NO.	2016-115		**SAMPLE DEPTH**		
TECH/TEST DATE	ELW 7/24/2016		**DATE RECEIVED**	7/21/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	675.3
Wt Dry Soil & Tare (gm)	(w2)	535.9
Weight of Tare (gm)	(w3)	15.7
Weight of Water (gm)	(w4=w1-w2)	139.4
Weight of Dry Soil (gm)	(w5=w2-w3)	520.2
Moisture Content (%)	(w4/w5)*100	27

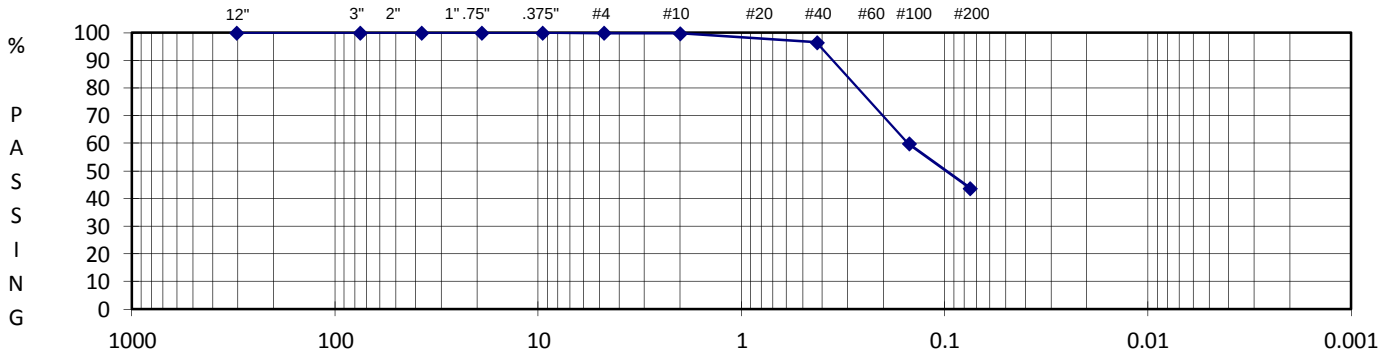
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		535.9
Tare Weight (gm)		15.7
(W6) Total Dry Weight (gm)		520.2

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.2**
% C SAND	**0.1**
% M SAND	**3.2**
% F SAND	**52.7**
% FINES	**43.7**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.7	0.00	0.00	100.00	cobbles
3.0"	15.7	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.7	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.7	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.7	0.00	0.00	100.00	fine gravel
#4	16.8	1.10	0.21	99.79	coarse sand
#10	17.1	1.40	0.27	99.73	medium sand
#20					medium sand
#40	34.0	18.30	3.52	96.48	fine sand
#60					fine sand
#100	224.8	209.10	40.20	59.80	fine sand
#200	308.4	292.70	56.27	43.73	fines
PAN	535.9	520.20	100.00	0.00	silt/clay



DESCRIPTION Silty fine SAND

USCS SM

Prepared For:

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mainvue Homes Carnation Property		**SAMPLE ID/TYPE**	IT-2	
PROJECT NO.	2016-115		**SAMPLE DEPTH**		
TECH/TEST DATE	ELW 7/24/2016		**DATE RECEIVED**	7/21/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	862.8
Wt Dry Soil & Tare (gm)	(w2)	704.8
Weight of Tare (gm)	(w3)	15.5
Weight of Water (gm)	(w4=w1-w2)	158.0
Weight of Dry Soil (gm)	(w5=w2-w3)	689.3
Moisture Content (%)	(w4/w5)*100	23

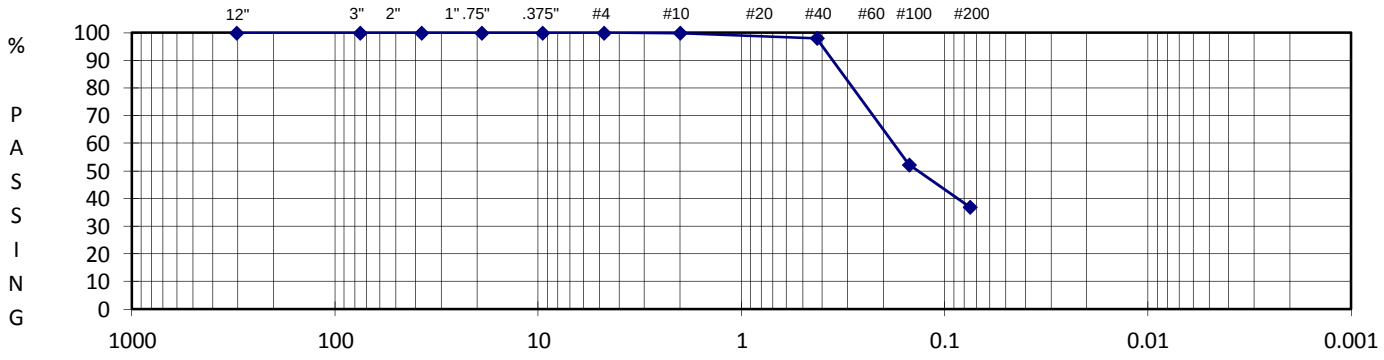
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		704.8
Tare Weight (gm)		15.5
(W6) Total Dry Weight (gm)		689.3

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.1**
% C SAND	**0.0**
% M SAND	**1.8**
% F SAND	**61.2**
% FINES	**36.8**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.5	0.00	0.00	100.00	cobbles
3.0"	15.5	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.5	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.5	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.5	0.00	0.00	100.00	fine gravel
#4	16.2	0.70	0.10	99.90	coarse sand
#10	16.5	1.00	0.15	99.85	medium sand
#20					medium sand
#40	29.1	13.60	1.97	98.03	fine sand
#60					fine sand
#100	344.7	329.20	47.76	52.24	fine sand
#200	451.0	435.50	63.18	36.82	fines
PAN	704.8	689.30	100.00	0.00	silt/clay



DESCRIPTION	Silty fine SAND
USCS	SM

Prepared For:

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Mainvue Homes Carnation Property		**SAMPLE ID/TYPE**	IT-3	
PROJECT NO.	2016-115		**SAMPLE DEPTH**		
TECH/TEST DATE	ELW 7/24/2016		**DATE RECEIVED**	7/21/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1476.5
Wt Dry Soil & Tare (gm)	(w2)	1443.6
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	32.9
Weight of Dry Soil (gm)	(w5=w2-w3)	1428.0
Moisture Content (%)	(w4/w5)*100	2

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

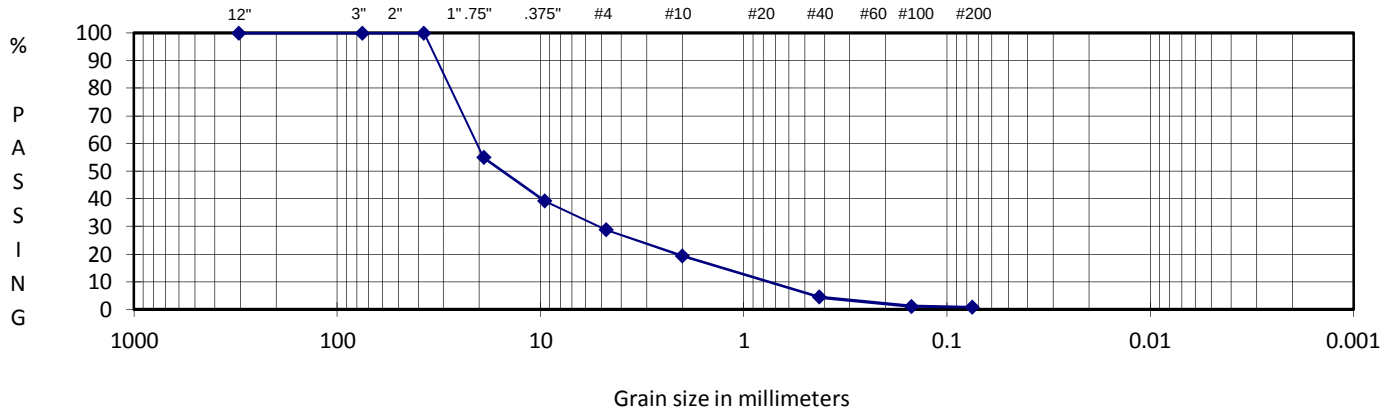
Weight Of Sample (gm)		1443.6
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		1428.0

% COBBLES	**0.0**
% C GRAVEL	**45.1**
% F GRAVEL	**26.1**
% C SAND	**9.4**
% M SAND	**14.9**
% F SAND	**3.7**
% FINES	**0.7**
% TOTAL	**100.0**

D10 (mm)	0.8
D30 (mm)	5
D60 (mm)	20
Cu	25.0
Cc	1.6

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.6	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	660.0	644.40	45.13	54.87	fine gravel
0.50"					fine gravel
0.375"	884.5	868.90	60.85	39.15	fine gravel
#4	1033.3	1017.70	71.27	28.73	coarse sand
#10	1167.7	1152.10	80.68	19.32	medium sand
#20					medium sand
#40	1379.9	1364.30	95.54	4.46	fine sand
#60					fine sand
#100	1427.5	1411.90	98.87	1.13	fine sand
#200	1433.2	1417.60	99.27	0.73	fines
PAN	1443.6	1428.00	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with some sand and trace silt
USCS	GW

Prepared For:

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	MainVue Homes Carnation Property		**SAMPLE ID/TYPE**	IT-4	
PROJECT NO.	2015-115		**SAMPLE DEPTH**		
TECH/TEST DATE	CM	1/13/2017	**DATE RECEIVED**	1/13/2017	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	608.6
Wt Dry Soil & Tare (gm)	(w2)	520.2
Weight of Tare (gm)	(w3)	132.5
Weight of Water (gm)	(w4=w1-w2)	88.4
Weight of Dry Soil (gm)	(w5=w2-w3)	387.7
Moisture Content (%)	(w4/w5)*100	23

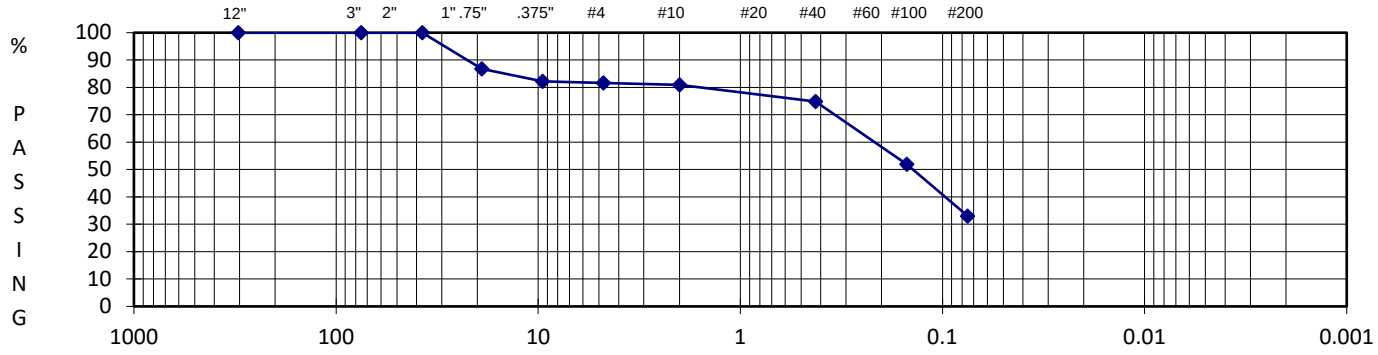
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		520.2
Tare Weight (gm)		132.5
(W6) Total Dry Weight (gm)		387.7

% COBBLES	**0.0**
% C GRAVEL	**13.3**
% F GRAVEL	**5.1**
% C SAND	**0.7**
% M SAND	**6.1**
% F SAND	**41.8**
% FINES	**33.0**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	132.5	0.00	0.00	100.00	cobbles
3.0"	132.5	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	132.5	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	183.9	51.40	13.26	86.74	fine gravel
0.50"					fine gravel
0.375"	201.6	69.10	17.82	82.18	fine gravel
#4	203.6	71.10	18.34	81.66	coarse sand
#10	206.5	74.00	19.09	80.91	medium sand
#20					medium sand
#40	230.2	97.70	25.20	74.80	fine sand
#60					fine sand
#100	318.7	186.20	48.03	51.97	fine sand
#200	392.2	259.70	66.98	33.02	fines
PAN	520.2	387.70	100.00	0.00	silt/clay



DESCRIPTION	Silty SAND with some gravel
USCS	SM

Prepared For:
MainVue Homes

Reviewed By: DB

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	MainVue Homes Carnation Property		**SAMPLE ID/TYPE**	TP-14	
PROJECT NO.	2015-115		**SAMPLE DEPTH**		
TECH/TEST DATE	CM	1/13/2017	**DATE RECEIVED**	1/13/2017	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	758.3
Wt Dry Soil & Tare (gm)	(w2)	615.0
Weight of Tare (gm)	(w3)	133.0
Weight of Water (gm)	(w4=w1-w2)	143.3
Weight of Dry Soil (gm)	(w5=w2-w3)	482.0
Moisture Content (%)	(w4/w5)*100	30

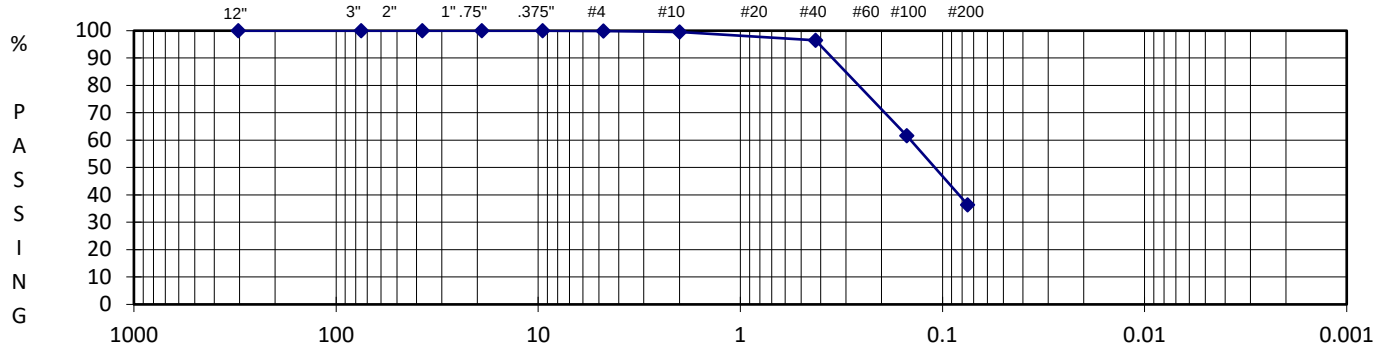
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		615.0
Tare Weight (gm)		133.0
(W6) Total Dry Weight (gm)		482.0

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.2**
% C SAND	**0.2**
% M SAND	**3.0**
% F SAND	**60.1**
% FINES	**36.4**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	133.0	0.00	0.00	100.00	cobbles
3.0"	133.0	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	133.0	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	133.0	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	133.0	0.00	0.00	100.00	fine gravel
#4	133.8	0.80	0.17	99.83	coarse sand
#10	135.0	2.00	0.41	99.59	medium sand
#20					medium sand
#40	149.7	16.70	3.46	96.54	fine sand
#60					fine sand
#100	317.8	184.80	38.34	61.66	fine sand
#200	439.5	306.50	63.59	36.41	fines
PAN	615.0	482.00	100.00	0.00	silt/clay



DESCRIPTION	Silty SAND
USCS	SM

Prepared For:
MainVue Homes

Reviewed By: DB

RILEYGROUP

Project Name: **MainVue Homes Carnation Property**
Project Number: **2016-115**
Client: **MainVue Homes**

RILEYGROUP

Key to Logs

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample Number: Sample identification number.
5. USCS Symbol: USCS symbol of the subsurface material.
6. Graphic Log: Graphic depiction of the subsurface material encountered.
7. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
8. REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

- AF
- Poorly graded GRAVEL (GP)
- Poorly graded GRAVEL with Silt (GP-GM)
- Grass and/or topsoil
- Well graded GRAVEL with Silt (GW-GM)
- SILT, SILT w/SAND, SANDY SILT (ML)
- Silty SAND (SM)
- Poorly graded SAND (SP)
- Poorly graded SAND with Silt (SP-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Auger sampler
- Bulk Sample
- 3-inch-OD California w/ brass rings
- CME Sampler
- Continuous
- Grab Sample
- 2.5-inch-OD Modified California w/ brass liners
- Pitcher Sample
- 2-inch-OD unlined split spoon (SPT)
- Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

- Water level (at time of drilling, ATD)
- Water level (after waiting)
- Minor change in material properties within a stratum
- Inferred/gradational contact between strata
- Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664

Professional Analytical Services

Jan 19 2017
Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Attention: MICHAEL ERDAHL

Dear MICHAEL ERDAHL:

Enclosed please find the analytical data for your 701135 project.

The following is a cross correlation of client and laboratory identifications for your convenience.

CLIENT ID	MATRIX	AMTEST ID	TEST
TP-14	Soil	17-A000472	CONV
IT-4	Soil	17-A000473	CONV

Your samples were received on Friday, January 13, 2017. At the time of receipt, the samples were logged in and properly maintained prior to the subsequent analysis.

The analytical procedures used at AmTest are well documented and are typically derived from the protocols of the EPA, USDA, FDA or the Army Corps of Engineers.

Following the analytical data you will find the Quality Control (QC) results.

Please note that the detection limits that are listed in the body of the report refer to the Practical Quantitation Limits (PQL's), as opposed to the Method Detection Limits (MDL's).

If you should have any questions pertaining to the data package, please feel free to conact me.

Sincerely,

Aaron W. Young
Laboratory Manager

Project #: 701135
PO Number: E-437

BACT = Bacteriological
CONV = Conventionals
MET = Metals
ORG = Organics
NUT=Nutrients
DEM=Demand
MIN=Minerals

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664
www.amtestlab.com

Professional Analytical Services

ANALYSIS REPORT

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Attention: MICHAEL ERDAHL
Project Name: 701135
Project #: 701135
PO Number: E-437
All results reported on an as received basis.

Date Received: 01/13/17
Date Reported: 1/19/17

AMTEST Identification Number **17-A000472**
Client Identification **TP-14**
Sampling Date **01/12/17, 10:00**

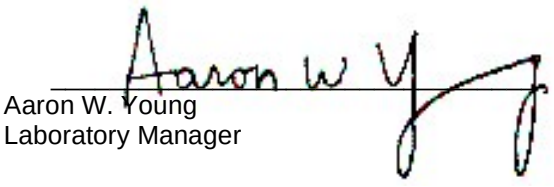
Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	12.	meq/100g		0.5	SW-846 9081	AY	01/19/17
Organic Matter	3.9	%		0.1	ASTM D 2974	SW	01/18/17

AMTEST Identification Number **17-A000473**
Client Identification **IT-4**
Sampling Date **01/12/17, 10:30**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	11.	meq/100g		0.5	SW-846 9081	AY	01/19/17
Organic Matter	3.9	%		0.1	ASTM D 2974	SW	01/18/17



Aaron W. Young
Laboratory Manager

Am Test Inc.
13600 NE 126th PL
Suite C
Kirkland, WA, 98034
(425) 885-1664
www.amtestlab.com

Professional Analytical Services

QC Summary for sample numbers: 17-A000472 to 17-A000473

DUPLICATES

SAMPLE #	ANALYTE	UNITS	SAMPLE VALUE	DUP VALUE	RPD
17-A000472	Cation Exchange Capacity	meq/100g	12.	12.	0.00
17-A000473	Organic Matter	%	3.9	3.8	2.6

STANDARD REFERENCE MATERIALS

ANALYTE	UNITS	TRUE VALUE	MEASURED VALUE	RECOVERY
Cation Exchange Capacity	meq/100g	4.0	4.0	100. %

BLANKS

ANALYTE	UNITS	RESULT
Cation Exchange Capacity	meq/100g	< 0.5
Organic Matter	%	< 0.1

SUBCONTRACT SAMPLE CHAIN OF CUSTODY

P.4

Send Report To Michael Erdahl

Company Friedman and Bruya, Inc.

Address 3012 16th Ave W

City, State, ZIP Seattle, WA 98119

Phone # (206) 285-8282 Fax # (206) 283-5044

SUBCONTRACTER Amtest

PROJECT NAME/NO. 701135

PO # E-437

REMARKS

Please Email Results

TURNAROUND TIME

☐ Standard (2 Weeks)

☑ RUSH ASAP

Rush charges authorized by:

SAMPLE DISPOSAL

☐ Dispose after 30 days

☐ Return samples

☐ Will call with instructions

						ANALYSES REQUESTED									
Sample ID	Lab ID	Date Sampled	Time Sampled	Matrix	# of jars	Dioxins/Furans	EPH	VPH	Nitrate	Sulfate	Alkalinity	TOC-9060M	Organic Content	Cation Exchange Capacity		Notes
TP-14	472	1/12/17	1000	Soil	2								X	X		
IT-4	73	↓	1030	↓	2								X	X		

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:		Michael Erdahl	Friedman and Bruya	1/13/17	11:30
Received by:	VCH	FedEx T=73		1/13/17	1240
Relinquished by:					
Received by:					

Tab 8.0

8.0 OTHER PERMITS

This section contains the following information:

Tab 9.0

9.0 OPERATIONS AND MAINTENANCE MANUAL

An Operations and Maintenance Manual will be provided in this section during Final Engineering Review

Tab 10.0

10.0 DECLARATION OF COVENANT FOR PRIVATELY MAINTAINED FLOW CONTROL AND TREATMENT FACILITIES

Tab 11.0

11.0 DECLARATION OF COVENANT FOR PRIVATELY MAINTAINED ON-SITE STORMWATER MANAGEMENT BMPS

Tab 12.0

12.0 BOND QUANTITIES WORKSHEET

A completed Bond Quantities Worksheet will be provided in this section during Final Engineering Review